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1982 NATIONAL FISHERIES SURVEY VOLUME I TECHNICAL REPORT: INITIAL FINDINGS

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1982 NATIONAL FISHERIES SURVEY
VOLUME I TECHNICAL REPORT: INITIAL FINDINGS

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I

DISCLAIMER

Although the research described in this article has been funded wholly or in part by the United States Environmental Protection Agency (EPA) through EPA-IAG-79-D-X0773 to the United States Fish and Wildlife Service, it has not been subject to EPA policy review and therefore does not necessarily reflect the views of EPA and no official endorsement should be inferred.

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PREFACE

Until recently, attempts to monitor the condition of the Nation's waters have focused only on the physical and chemical characteristics of the water, while the components of the biological communities were largely ignored. Additionally, these physical and chemical data were not collected in the context of a statistically designed evaluation. A link between the physical and chemical characteristics and the associated health of the biological communities was clearly needed.

The National Fisheries Survey (Survey) represents the first statistically designed survey of the status of the Nation's waters, their fish communities, and the limiting factors affecting these fish communities. As such, the results of this Survey represent a baseline assessment of the biological quality of the Nation's waters. For the purposes of this report, the Nation's waters are defined as all flowing, freshwater streams and rivers and their associated impoundments in the contiguous 48 United States. Specifically excluded in this definition are wetlands, the Great Lakes, coastal waters, and tidal estuaries. This Survey report can serve as a valuable reference for all agencies responsible for or concerned about the quality of the Nation's waters and their associated fisheries and wildlife. The results presented are the culmination of a 5-year interagency agreement between the U.S. Environmental Protection Agency and the U.S. Fish and Wildlife Service. They are preliminary in that the enormous data base collected by the Survey can be further analyzed to provide additional information on relationships between limiting factors and the sources associated with these factors. The Survey can also be repeated in the future to provide trend data useful in monitoring the status of the Nation's waters.

This report is the first in a three-volume series and is intended for use by professional fishery biologists and water quality management personnel; Federal and State decisionmakers and planners; and the general public. Volume II contains information on the statistical design used to select the Survey sample and to analyze the data (Glauz, W.D. 1984. 1982 National Fisheries Survey. Volume II: Survey design. U.S. Fish Wildl. Serv., FWS/OBS-84/14. 77pp.). Volume III contains the detailed implementation plan used to conduct the Survey (Judy, R.D., Jr. and P.N. Seeley. 1984. 1982 National Fisheries Survey. Volume III: Survey protocol. U.S. Fish Wildl. Serv., FWS/OBS-84/07. 43pp.).

The reader should keep in mind specific programs and agency needs relevant to this Survey and the fact that the Survey is intended as a National assessment. State-by-State and regional comparisons can not be made. In light of the results presented with this report, additional analyses of the data would be desirable and are strongly encouraged.

EXECUTIVE SUMMARY

This report presents initial results of the National Fisheries Survey, an assessment of the biological condition of the Nation's waters conducted jointly by the U.S. Environmental Protection Agency (EPA) and the U.S. Fish and Wildlife Service (FWS) in 1982. Sport fish species, Federally-designated threatened and endangered fish species, and State-designated fish species of special concern were used as indicators of biological status. For the purposes of this Survey, the Nation's waters were defined as all flowing waters in the contiguous 48 United States, including main stem impoundments but excluding the Great Lakes, estuaries, coastal waters, and wetland areas.

The Survey was based on a statistically selected sample of 1,303 river segments from across the Nation using a questionnaire developed by the EPA, the FWS, and their contractors. The respondents were State fish management experts with an average of 9 years of experience in the selected cataloging units or watersheds. An assessment of the fisheries information collected shows that 40% of the reaches had been quantitatively or qualitatively sampled. Sampling occurred in surrounding cataloging units for an additional 33% of reaches. Twelve hundred and eighty-five questionnaires, 98.5% of the total distributed, were completed and returned to the Survey project team. The Survey design, the probability structure used to select the sample reaches, the experience level of the respondents, and the high response rate combine to provide reliable estimates of the status of the Nation's waters, accurate appraisals of their ability to support fish communities, and informed judgements on limiting factors affecting those fish communities.

The respondents were asked to provide information on four basic issues: the fish species occurring in each reach; the time of year during which the segment is usable as fish habitat; conditions adversely affecting fish in the reach; and trends in reach conditions. The respondents also described what kinds of fisheries data were available for the reach. In the analysis, estimates were derived for all waters and for perennial waters only.

This report is the first in a three-volume series and is intended for use by professional fishery biologists and water quality management personnel; Federal and State decisionmakers and planners; and the general public. Volume II contains information on the statistical design used to select the sample streams in the Survey and the analysis of the data. Volume III contains a detailed description of the procedure used to conduct the Survey, including measures followed to ensure consistent handling of data, questions asked, and tracking of questionnaires prior to their return to the Survey project team.

Summary of Survey Results

The Survey is a National assessment and the following facts should be remembered as the Survey results are reviewed:

- The Survey results are presented as National level estimates and no State-by-State comparisons can be made.
- The Survey results are based only on the Nation's flowing waters and associated impoundments. The Great Lakes, estuaries, coastal waters, and wetlands were not included.
- The respondents were experienced fishery biologists.
- The focus of the Survey was the fish community and associated habitat.
- The Survey results must be evaluated within the context of the questionnaire.
- The Survey results are preliminary. Further analyses of these data are necessary to establish definitive relationships between characteristics.

Estimates derived from the Survey responses to a variety of different questions about fish populations, limiting factors such as water quality problems which affect those fish populations, and overall assessments of reach conditions, were found to largely confirm each other within an acceptable margin for error. The picture which emerges from these responses is of waters which, to a large degree, are able to support viable fish populations but which are nevertheless widely affected by pollution, especially from nonpoint sources, and by problems with water quantity, primarily natural low flows. Specific highlights of the Survey results are as follows:

Fish Distribution: Sport fish species which are generally thought to be intolerant of poor water quality are widely distributed, occurring in an estimated 73% of the Nation's waters. Anadromous sport fish species, such as salmon and steelhead trout, occur in 11% of the total stream miles. Commercial fish species occur in 17% of all waters, indicating that freshwater commercial fish populations are an important part of our overall aquatic resources. Nonsport fish species occur in 68% of the Nation's waters, with nonsport anadromous species, such as shad, occurring in only 2% of the total stream miles. Sport fish are abundant in 23% and common in 41% of all waters. The majority (67%) of streams are presently suitable as sport fish habitat.

Results of the Survey show that the two most prevalent sport fish species are the largemouth bass (Micropterus salmoides) and the rainbow trout (Salmo gairdneri), which occur in approximately half of the Nation's waters. The current distribution of these two species may be a result of intensive stocking efforts used in the past to broaden their ranges.

An attempt was made to determine whether sport fish occurrence was restricted to a portion, e.g., upper 25%, of each sample reach. In general, it was found that if sport fish occurred anywhere within the reach, they were distributed throughout the entire reach.

Overall, fish stocking to enhance or maintain sport fish populations does not presently occur in many of the Nation's waters. Less than 10% of the Nation's streams are being stocked at this time. Present stocking relies primarily on fingerlings and catchable-sized fish. Fingerlings are stocked in 8% of the streams, compared to catchable-sized fish in 7% of the streams.

The common carp (Cyprinus carpio), an introduced species, is the most prevalent nonsport fish species. Carp occur in 19% of the Nation's waters, followed closely by a native species, the creek chub (Semotilus atromaculatus), which occurs in 18% of the Nation's waters.

Only 0.8% of the Nation's waters contain Federally-designated threatened and endangered species, compared to 2.4% that contain State-listed species of special concern.

Twenty-one percent of the Nation's streams contain no fish. Most of these reaches, however, are dry during part or all of the year. In a normal water year, 69% of the Nation's waters have water usable all year around as fish habitat; 14% are not usable as fish habitat during any part of the year because of low or no flow. The remaining waters are usable as fish habitat during only part of the year, primarily in the spring and summer. Most of the waters that contain fish are used year-round for spawning, hatching, as nursery habitat and for overwintering. Twelve percent of the Nation's waters serve as migration routes.

Limiting Factors Affecting the Fish Community: A significant percentage (81%) of the Nation's fish communities are adversely affected by limiting factors which are linked to a variety of sources.

Water quality is reported to adversely affect the fish community in 56% of the Nation's waters. The predominant water quality factors are turbidity (affecting 34% of all waters); high water temperature (affecting 26% of all waters); nutrient surpluses (affecting 13% of waters); toxic substances (affecting 10% of waters); and low concentrations of dissolved oxygen (also affecting 10% of waters). More than one limiting factor can occur in each reach.

The major causes of water quality problems in order of number of stream miles affected are total nonpoint sources, agricultural sources, natural sources, and total point sources. Overall, nonpoint sources contribute to water quality problems in 38% of all waters and are ranked as major concerns in 19% of waters. Twenty-nine percent of all waters are adversely affected by agricultural sources of pollution, which are ranked as major concerns in 17% of waters. Natural sources are the third-ranked contributors to water quality degradation and occur in 22% of all waters.

Point sources of pollution also affect the quality of the Nation's waters. Although municipal and industrial point source dischargers are located on, or have the potential to affect, only about 20% of the Nation's waters, the Survey found that over 10% of all waters are adversely affected by point sources, and that in 5% of all waters, point sources are ranked as major concerns.

Water quantity problems adversely affect the fish community in 68% of the Nation's waters and 41% of perennial waters. Major water quantity problems include: below optimum flows, occurring in 32% of waters; occasional low flows, occurring in 23% of waters; and excessive flow fluctuations occurring in 17% of waters. Natural conditions are the primary causes of these problems, and affect flow in half of the Nation's waters. Agricultural diversions adversely affect 14% of all waters.

Stream habitat conditions limit the fish community in at least 49% of the Nation's waters. The predominant limiting factors are a lack of adult and juvenile habitat (in 40% of the Nation's waters) and of egg and larvae habitat (in 28% of waters). Other major components of aquatic habitat, such as pools, spawning gravels, overhead cover, and riffles, are also absent or degraded in many waters. Major causes of habitat problems are, in decreasing order of importance, excessive siltation, bank erosion and sloughing, natural causes, and channelization.

Significant limiting factors also occur within the fish communities, including fish kills (15% of waters) and contamination of fish flesh (9% of waters). Probable sources of these problems are natural causes, pesticides, and other noxious or toxic substances.

Reach Conditions and Trends: The respondents were asked to evaluate each sample reach's ability to support healthy, reproducing sport fish populations. It was estimated that 67% of the Nation's waters have at least a minimum ability to support sport fish. Approximately 23% cannot support any fish populations at all. Ten percent are able to support populations of nonsport fish species, which are generally considered to be more tolerant of adverse aquatic conditions. Many of the waters which cannot support fish are intermittent and are not likely to improve.

The Survey was designed to elicit responses concerned with past, present, and future trends in the status and condition of the fish community in each reach. Although the responses were speculative, the resulting information provides insights into the effectiveness and direction of numerous water-related Federal programs.

The ability of the Nation's waters to support sport fish has not changed appreciably during the last 5 years. Overall, 91% of the streams have maintained their ability while 5% have been degraded and 4% have improved. Based on respondent speculations, comparisons with conditions projected 5 years in the future indicate that the Nation's waters may be degraded without controls on man-caused limiting factors that adversely affect fish communities.

These Survey results indicate that there are problems with the Nation's waters even though the majority of these waters presently support fish. Natural causes and agriculturally-related nonpoint sources of pollution appear to be a potential constraint to the continued viability of the sport fish communities.

Recommendations

Recommendations resulting from this Survey focus on additional data analyses that need to be conducted to provide further insight into relationships between sources and limiting factors. Additionally, recommendations are made concerning the use of this Survey methodology in conducting other similar surveys.

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- Wetland Ecology Group, Western Energy and Land Use Team, U.S. Fish and Wildlife Service, Fort Collins, Colorado.

- Office of Water Regulations and Standards, Monitoring and Data Support Division, U.S. Environmental Protection Agency, Washington, D.C.

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  - survey design

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  - questionnaire design
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CHAPTER 1. INTRODUCTION

This report presents the initial results of a major effort to assess the biological conditions of streams in the United States by examining aquatic habitat and fish communities. For the purposes of the Survey, the Nation's waters were defined as all flowing fresh surface waters of the contiguous 48 United States, including impoundments, ditches, and canals shown on U.S. Geological Survey (GS) 1:500,000 scale Hydrologic Unit Series maps. Specifically excluded were the Great Lakes, wetlands, coastal waters, and estuaries. Approximately 1 million miles of streams served as the universe for the Survey.

PROJECT BACKGROUND

The U.S. Fish and Wildlife Service (FWS) and the U.S. Environmental Protection Agency (EPA) identified the need for a survey, based on existing information, for use in evaluating the biological status of the Nation's waters, pursuant to EPA's responsibilities under Sections 101(a) and 104(a)(5) of the Clean Water Act, P.L. 95-217. In July, 1978, the FWS and the EPA entered into a multiphased, 5-year interagency agreement to determine the availability of biological data and to identify limiting factors affecting aquatic communities. This interagency agreement also provided for the development of a statistical methodology to be used to select rivers of interest and to analyze fisheries data collected on a National scale. The interagency agreement was also the vehicle used for implementing and conducting the Survey. These efforts utilized the River Reach File (RRF) concept which was developed concurrently.

The RRF was developed by the EPA to catalogue all of the Nation's waters by assigning a unique alpha-numeric identifier to each stream segment or reach. The term "reach" refers to that portion of a stream or river which extends downstream from one confluence of a stream, river, or lake to the next confluence. Reaches are defined with reference to the specific map scale cited above.

Water bodies in the RRF were digitized from National Oceanographic and Atmospheric Administration (NOAA) aeronautical charts, labeled, linked hydrologically, and then computerized. Each reach was identified by an 11-digit code with the first 8 digits representing the GS cataloging unit code and the last three the unique river reach code.

An assessment of data availability was the second major task undertaken prior to the development of the Survey methodology. This assessment was conducted at an interagency workshop involving technical experts from State and Federal water resource agencies and universities and was designed to determine the availability of quantitative and qualitative descriptors of aquatic systems. The workshop also defined those descriptors which were desirable and feasible to collect for an assessment of the biological quality of the Nation's waters. Results of the workshop were described in detail in the River Reach Phase II Report: A Standardized Method for Classifying Status and Types of Fisheries (Olson et al. 1981). A series of classification descriptors or criteria were proposed that could be used for classifying status and types of fisheries.

Based on the assessment of data availability, a pilot questionnaire was developed and tested in eight states. The results of the pilot testing were reported in the Draft Reach File Status Report: Pilot Survey Results (Olson and Nystrom 1982). The conclusions were that data availability on fish communities and other stream characteristics varied greatly among States and that the pilot questionnaire was too lengthy to be completed easily by State fishery biologists. The focus on obtaining quantified information for all reaches was dropped because these data were not generally available. A modified, shorter questionnaire that requested the kinds of information generally available in all States was developed. This modified questionnaire (Appendix A) was the basis for the present Survey effort.

THE SURVEY

Objectives for the Survey were developed as a part of the interagency agreement. The objectives were:

- The production of statistically-based estimates of the ability of the Nation's water to support sport fish communities and species of special concern;
- The development of a method to assess fish community conditions that was feasible to implement and practical to use;
- The development of techniques that had Nationwide application;
- The compilation of predominantly existing data (where possible); and
- The development of a system that was amenable to updating and revision on a regular basis.

These objectives were the focus of the Survey and directed the type of data analyses and quality control procedures used.

The Survey used biological conditions as an indicator for several reasons. Presence or absence, abundance, and type of organisms present in a water body can provide useful information from a monitoring and management perspective. Displayed over time, trends in biological conditions can provide decisionmakers with information useful in making changes in management strategies for both fisheries and water quality.

The fish community, and, particularly, sport fish and fish species of special concern such as threatened and endangered species, were selected as the biological indicators for the Survey because they are generally present in most perennial water bodies and they react to changes in water quality, quantity, and other factors by mortality, migration, changes in community composition, and reproductive success. Fish effectively represent the biological community because their presence, abundance, and species' habitat needs reflect the physical and chemical conditions occurring in the water body. Additionally, most State Fish and Game Agencies have concentrated their efforts to acquire data on sport fish populations. Because of their expertise with sport fish species and species of special concern, staff within these agencies were chosen as the Survey respondents.

The Survey is closely related to other programs being conducted by the FWS and EPA. Generally, the relationship is one of data acquisition to support, monitor, and manage the Nation's natural resources. One related activity within the FWS is the National Hunting and Fishing Survey (U.S. Fish and Wildlife Service and U.S. Bureau of the Census 1982), which focuses on the attitudes, activities, and desires of the public with regard to the fish and wildlife resources. Also related are the FWS Regional Resource Plans which, taken together, identify and assign priorities to the Nation's fish and wildlife resource problems and related management efforts. Presently the survey instrument serves as the basic structure for a FWS computerized fishery management tool called the River Reach Fisheries Information System (RRFIS).

The EPA programs that relate most closely to the Survey include the National Water Quality Inventory Report to Congress, which is a compilation and analysis of Section 305(b) reports on water quality conditions submitted to EPA by the States. These reports provide the Congress with a summary of water quality conditions and trends which can be useful in allocating resources for activities mandated by the Clean Water Act. The Survey is also commensurate with an increased emphasis in EPA on the use of biomonitoring for National assessments.

CHAPTER 2. METHODOLOGY

DESIGN OF THE SURVEY

The Survey was designed by the EPA and its contractors to gather information on fish communities, limiting factors and associated sources adversely affecting fish communities, and the ability of the Nation's waters to support fish communities. Reaches to be sampled were selected from the total number of reaches using a probability sampling design.

For a complete description of the statistics used in designing the sample strategy, see Volume II: Survey design (Glauz 1984).

The RRF concept was selected as the sampling frame because it met the statistical requirements of the survey design. However, the coverage in the RRF was inadequate for the purposes of the Survey and it would have been prohibitively expensive to modify it to the necessary level of detail. Therefore, a two-stage sampling design was chosen.

The first stage sample was selected from the universe of the 2,101 cataloging units (watersheds) in the contiguous United States. This first stage universe of GS cataloging units was stratified to ensure a representative distribution of the sample with the following stratification variables:

- Large river systems, such as the lower Mississippi and lower Missouri River main stems;
- Presence or absence of one or more cities of 100,000 population or more;
- Dry or humid ecoregion;
- Percentage of total area in irrigated cropland;
- Percentage of total area in non-irrigated cropland; and
- Percentage of total area in rangeland.

A sample of 302 cataloging units was selected from the 14 strata with probability proportional to size (total miles of water contained within the unit) and with minimum replacement. Figure 1 shows the distribution of these 302 cataloging units.

The RRF was expanded for these 302 cataloging units to include all reaches depicted on the GS 1:500,000 scale Hydrologic Unit Series maps. It was recognized that the use of such a large scale map could potentially omit

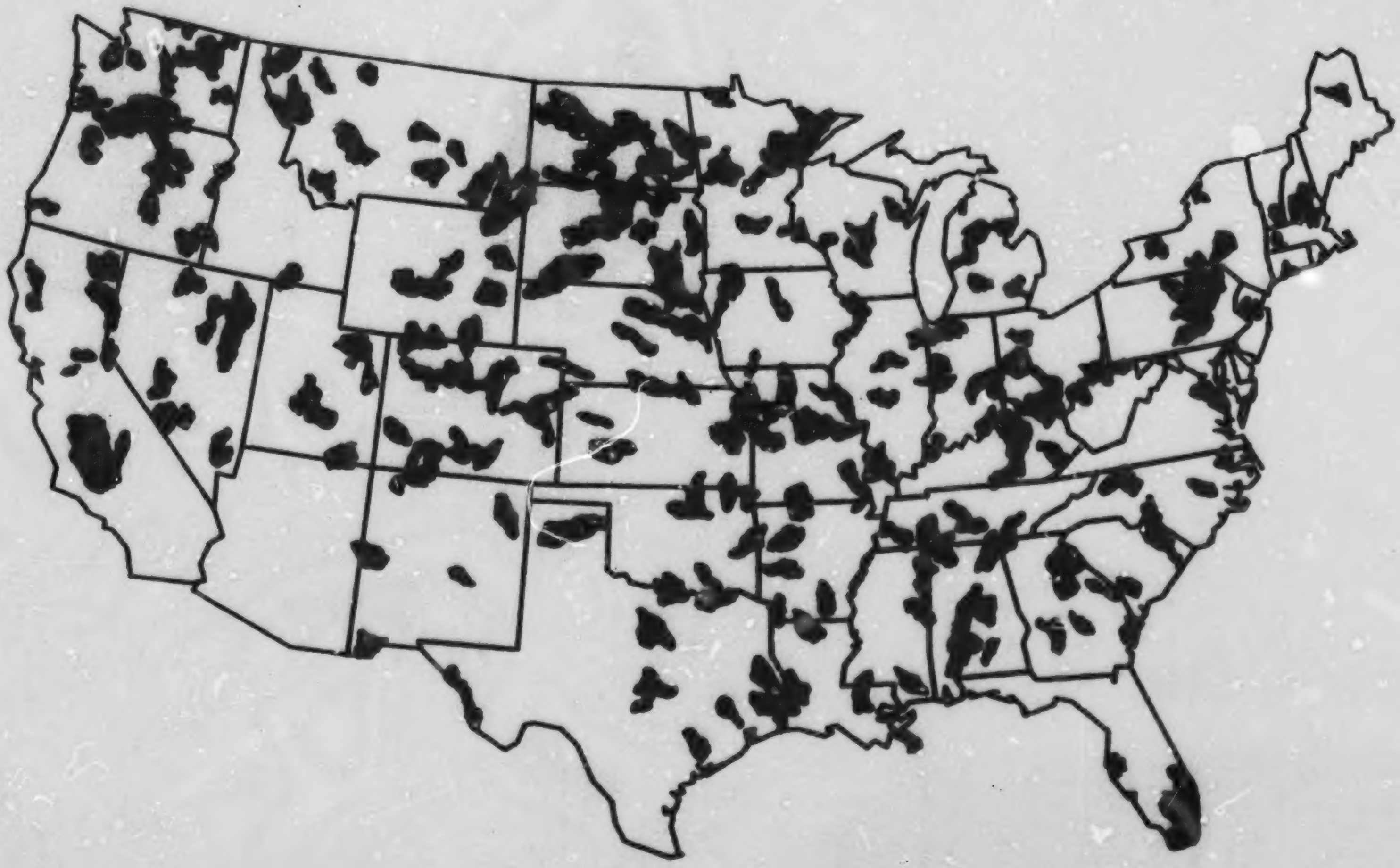

Figure 1. Distribution of cataloging units used in the National Fisheries Survey.

small perennial streams that may contain aquatic life. In order to estimate the percentages and types of streams that could be omitted, Keup (N.D.) compared the results of using 1:62,500 and 1:500,000 scale maps to estimate total stream lengths and volumes. Keup estimated that the 1:500,000 scale maps include between 65% and 75% of the Nation's river surface acres and between 96% and 98% of the total river volume. Because volume is closely associated with available fish habitat, using the RRF at the 1:500,000 scale was not considered to impose an important limitation on the Survey results. This is especially true for a Nationwide assessment.

The second stage of the sample design selected reaches from the first stage sample, again with probability proportional to their size and with minimum replacement. A total of 1,303 reaches were selected, each with a known probability of selection. These reaches represented the ultimate sample of reaches for the Survey.

The Survey questionnaire was based on the results of the pilot test and on input from a committee of biologists, survey statisticians, and questionnaire design experts.

The fish community was selected as the best indicator of biological conditions. Several quantitative measures of the fish community were considered but not used because, based on the vast differences in the fish community Nationwide and the lack of existing data, no one indicator would have resulted in acceptable estimates of the status of the Nation's waters with respect to their ability to support fish.

The final questionnaire (Appendix A) was a mix of questions that closely addressed the objectives of the Survey. The shortened version used in the Survey minimized the burden on the respondents and could be completed with existing information. These two factors were critical to ensuring a high response rate. The Survey questionnaire was also designed to lead each respondent through the questions in such a way that all information necessary to evaluate the conditions within a reach were adequately addressed prior to the actual evaluation of overall condition. The Survey questionnaire was approved by the Office of Management and Budget (OMB) under the Paper Work Reduction Act (OMB Number 2000-0410).

THE SURVEY QUESTIONNAIRE

To assist the reader in following the results, discussions, and conclusions presented in this report, a brief description of each question is presented.

Question 1 requested detailed information on all fish species present, their classes, the life stages that used the reach, their abundance and occurrence in the reach, whether or not they were stocked, and the frequency of stocking.

Question 2 requested information on whether or not the reach and/or surrounding cataloging unit had been sampled qualitatively and quantitatively and the dates of sampling.

Question 3 requested information on whether or not the reach contained water usable as habitat by fish in a normal water year. If it did not contain water all year, the biologist was asked to indicate the months that water was available.

Question 4 requested if the use, survival, or productivity of the fish community was adversely affected by man-caused or natural factors. It also requested information on the limiting factor(s) and associated source(s) that were thought to adversely affect the fish community in the reach. Four general response categories were included: water quality, water quantity, usable habitat, and problems in the fish community. Several limiting factors and sources were listed for each category. If a factor was checked, the biologist was asked to indicate whether it was a major or a minor concern.

Questions 5 through 9 requested the biologist to rate the reach with respect to its ability to support sport fish and species of special concern. These ratings were on a scale from 0 to 5. Zero represented a reach that would not support any fish. A rating of 5 indicated that the reach had maximum ability to support a community of sport fish or species of special concern.

Question 5 requested a rating of the reach at the present time. Question 6 involved ranking of the reach as it was 5 years ago. Questions 7 and 8 requested the respondent to speculate on future conditions in the reach. Question 7 involved a projection of how the reach would be in 5 years if present trends continued. Question 8 involved a projection of how the reach would rank in 5 years if any man-caused limiting factors were controlled. Question 9 asked for a ranking, on the same scale, of the reach in the same or adjacent cataloging unit or watershed that had the greatest ability to support sport fish. Data from Question 9 were not used in the analysis because the biologist's choice was not restricted to the same cataloging unit as the selected reach. Because of the large possible selection of cataloging units adjacent to the selected reach, inconsistencies in responses were noted and any comparative value of the responses was lost. Also, response to this question was below that which was necessary to derive informative estimates.

The analyses of the response to each of the questions asked by the Survey, excluding Question 9, are presented in Chapter 3.

SURVEY IMPLEMENTATION

Implementation of the Survey was dependent on cooperation between the FWS and State fishery management agencies (Appendix B). Care was taken to ensure that as many questionnaires as possible were returned and that questions concerning the Survey were responded to in a similar manner. For a complete description of the Survey protocol, see National Fisheries Survey Volume III: Survey protocol (Judy and Seeley 1984).

Returned questionnaires were edited as described in Volume III. The edited questionnaires were transmitted to the FWS, Western Energy and Land Use Team (WELUT) where the responses to each question were entered into a computer. A copy of the master data tape was sent to the EPA, Washington, DC for data analysis. A List of Common and Scientific Names of Fishes from the United States and Canada (American Fisheries Society 1980) was used to standardize all fish species names. The list of fish species occurring in reaches sampled by the Survey is included in Appendix C.

DATA ANALYSIS

All data analysis was provided by the EPA and its contractors. Responses to each question were weighted according to the sample weights determined by the sampling design used in sample selection. Some modification of the sampling weights was undertaken to compensate for missing data. The methods used to analyze the data are described in Volume II of the National Fisheries Survey (Glauz 1984). Estimates are presented in this report as the percentage of stream miles nationally.

Two types of data analyses were completed. The first analysis estimated the occurrence of each parameter of interest in all waters -- perennial and intermittent. The second analysis focused on streams that were perennial. These two analyses provided for the determination of conditions on an "all streams" basis and for "perennial streams" only. Thus, comparisons could be made between "all streams" and streams that would be more likely to contain fish communities.

The data analysis provided estimates of the extent of a given area of interest with respect to the overall length of streams. They did not test for direct cause and effect relationships. The statistical tables generated during the data analyses are included in Appendix D.

CHAPTER 3. RESULTS

Results are presented as estimates of the percent of total miles of streams in the Nation that possess a given characteristic. Although the term "stream miles" is used here for convenience, these mileages include sections of impoundments, ditches, and canals as well as streams and rivers. Perennial streams were described separately for some questions. The total estimated number of stream miles was used as the denominator in all calculations. Therefore, the estimated results for both "all" and "perennial" streams are a percentage of all streams in the Nation. The estimates of the occurrence of each characteristic include the confidence interval in miles, based on the sampling error in the estimate and the bias potential due to missing data. Because of category overlap and missing data, percentages do not necessarily total 100 percent in all cases.

The following facts should be remembered as the results are reviewed:

- The Survey results are presented as National level estimates and no State-by-State comparisons can be made.
- The Survey results are based only on the Nation's flowing waters and associated impoundments. The Great Lakes, estuaries, coastal waters, and wetlands were not included.
- The respondents were experienced fishery biologists.
- The focus of the Survey was the fish community and associated habitat.
- The Survey results must be evaluated within the context of the questionnaire.
- The Survey results are preliminary. Further analyses of these data are necessary to establish definitive relationships between reach characteristics.

An assessment of the fisheries information collected in the sample shows that 40.0% of the reaches were themselves quantitatively or qualitatively sampled. Where sampling had not occurred specifically in the reach, it did occur in the surrounding cataloging unit for another 33.0% of the reaches. In many cases, these reaches were adjacent to the selected reach segment. The characteristics of these reaches were believed applicable to the selected reach by the questionnaire respondents because of the similarity between fish species and habitat conditions. In the few cases where the respondent had reservations about applying results from a similar reach in the cataloging unit to the selected reach, surveys were sometimes conducted to determine the biological condition and limiting factors. In total, fish community and limiting factor data had been collected on 73.0% of the selected reaches.

The remaining reaches were not sampled for fish community data, and data on similar reaches in the same cataloging unit were not available. It appears that the lack of data for these reaches corresponds to the fact that they are intermittent streams; State agencies responsible for fisheries management usually focus their resources on perennial streams.

The Survey questionnaire contained three questions related to the respondent's experience. The average fisheries experience of the respondents was 14 years, with a range from 2 to 34 years (Figure 2). Years in the current position ranged from 2 to 32, with an average of 8 years (Figure 3). Experience with streams in the selected cataloging units or watersheds ranged from 2 to 34 years, with an average of 9 years (Figure 4). These overall levels of experience indicate the high level of knowledge of the State respondents and greatly increased the validity of their responses.

QUESTION 1 - THE NATION'S FISH COMMUNITIES

Each respondent was requested to provide information on several aspects of the fish community. This information was used to evaluate the National distribution of fish species, the predominant fish classes (i.e., sport and nonsport), the abundance of fish, and whether or not stocking of the species is occurring on a major scale. The results for Question 1 are discussed based on these subdivisions.

Fish Species Present

Each respondent was requested to provide detailed information on the fish community present in the sample reach. National estimates were calculated for only the 10 most prevalent species for sport and nonsport fish (Table 1). Sport fish were defined as any fish with a legal limit (numbers, weight, or volume) set by the States. A complete list of the 425 fish species recorded present in the selected reaches is included with this report as Appendix C.

Results of the Survey, as shown in Table 1, indicate that the largemouth bass (Micropterus salmoides) and the rainbow trout (including steelhead) (Salmo gairdneri) are the most prevalent sport fish. Largemouth bass are estimated to be present in 27.3% of the Nation's waters while rainbow trout are present in 22.1%. Other prevalent sport fish species, in descending order of abundance, are bluegill (Lepomis macrochirus), channel catfish (Ictalurus punctatus), smallmouth bass (Micropterus dolomieui), green sunfish (Lepomis cyanellus), brook trout (Salvelinus fontinalis), black crappie (Pomoxis nigromaculatus), spotted bass (Micropterus punctulatus), and rock bass (Ambloplites rupestris).

The most prevalent nonsport fish species are the common carp (Cyprinus carpio) and the creek chub (Semotilus atromaculatus), which are present in 19.4% and 18.3% of the Nation's waters, respectively. Other prevalent nonsport fishes include the white sucker (Catostomus commersoni), gizzard shad

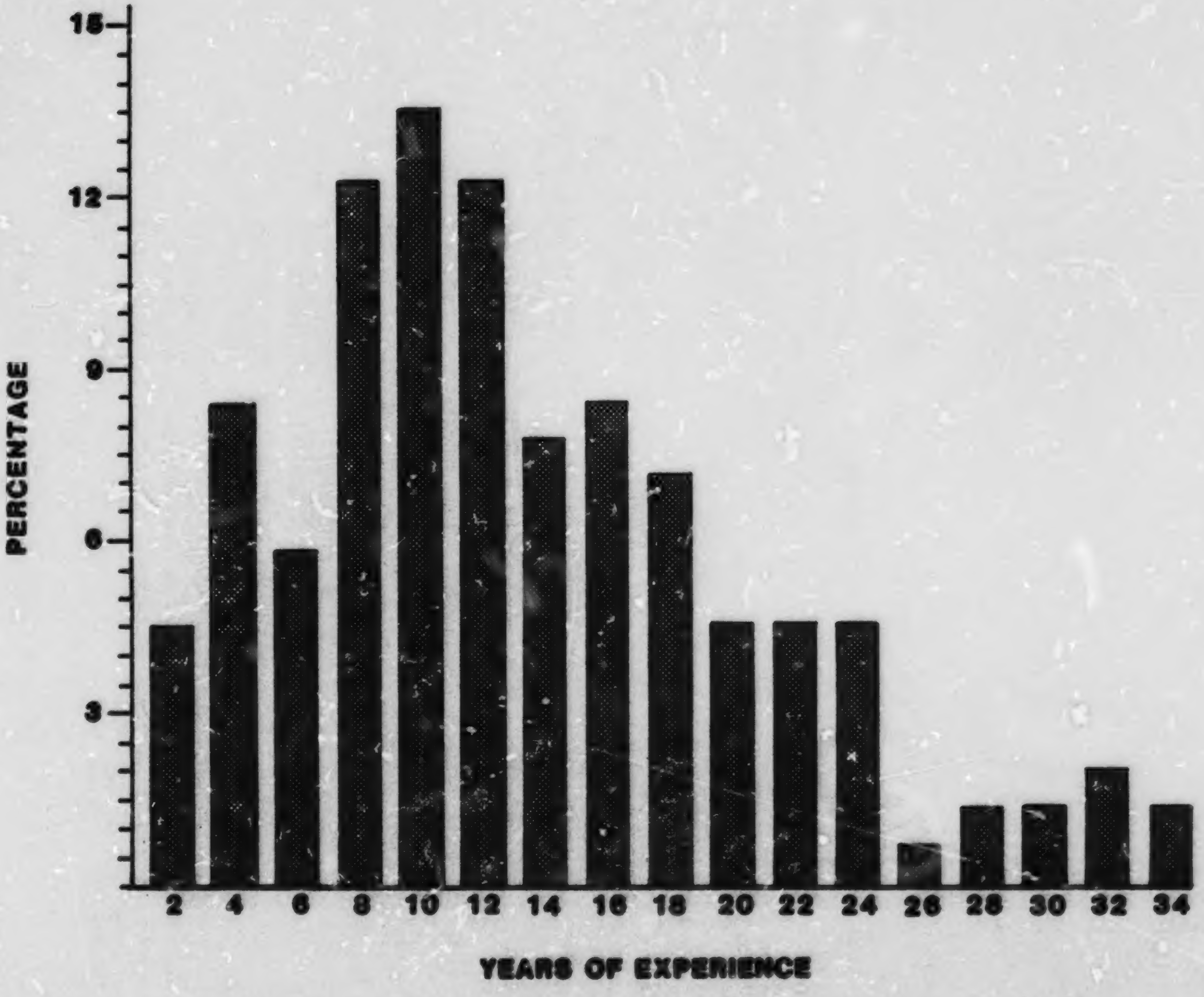

Figure 2. Years of experience of fishery biologists participating in the National Fisheries Survey.

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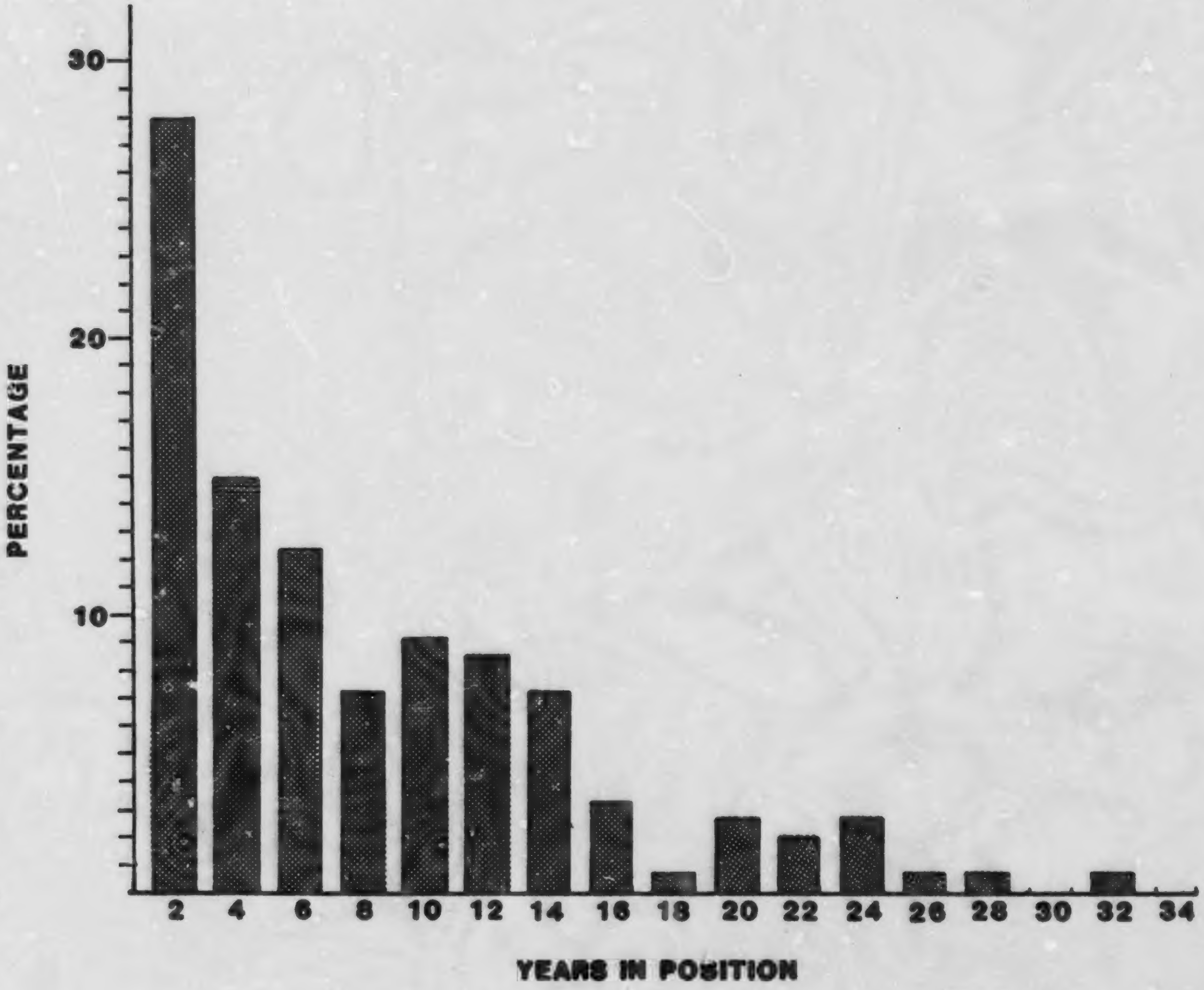

Figure 3. Years of experience in present position of fishery biologists participating in the National Fisheries Survey.

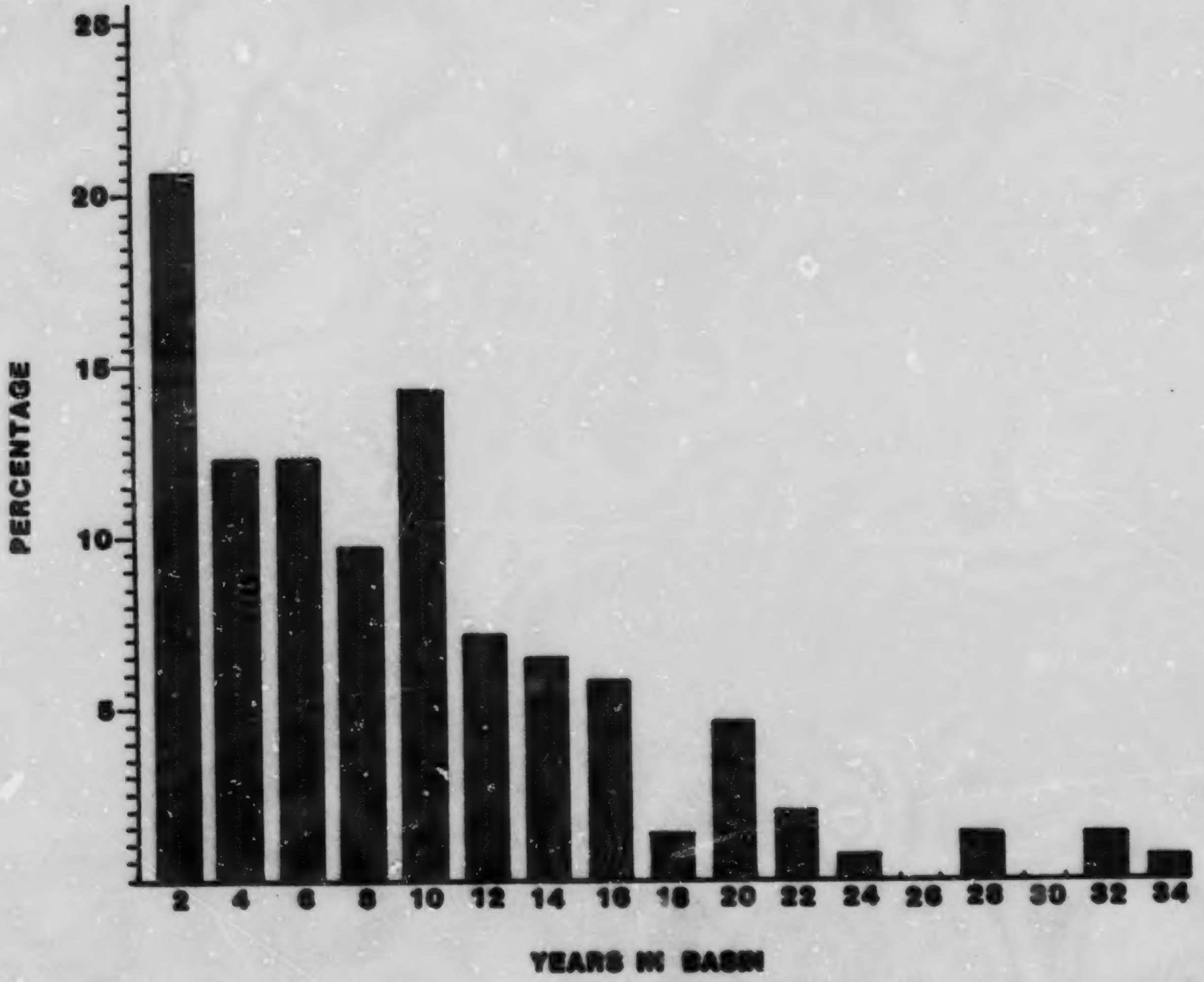

Figure 4. Years of experience in the selected river basins of fisheries biologists participating in the National Fisheries Survey.

Table 1. Ten most prevalent sport[a] and nonsport fish species occurring in the Nation's waters.

Species	Streams Miles	 Percentage[b]
Largemouth bass	263,859	27.3
Rainbow trout	213,461	22.1
Bluegill	188,495	19.5
Channel catfish	148,343	15.4
Smallmouth bass	142,142	14.7
Green sunfish	126,074	13.1
Brook trout	103,507	10.7
Black crappie	98,190	10.2
Spotted bass	98,129	10.2
Rock bass	94,682	9.8
Nonsport Fish Species		
Common carp	187,417	19.4
Creek chub	176,709	18.3
White sucker	166,823	17.3
Gizzard shad	131,730	13.6
Bluntnose minnow	126,665	13.1
Stone roller	122,337	12.7
Green sunfish	115,234	11.9
Common shiner	112,112	11.6
Fathead minnow	110,531	11.4
Golden shiner	106,602	11.0

[a] Additional statistics are presented in Appendix D, Table D-1a and b.
[b] Occurrences were not estimated separately for perennial streams.

(Dorosoma cepedianum), bluntnose minnow (Pimephales notatus), stoneroller (Campostoma anomalum), green sunfish (Lepomis cyanellus), common shiner (Notropis cornutus), fathead minnow (Pimephales promelas) and golden shiner (Notemigonus crysoleucas). The green sunfish is considered to be both a sport and nonsport fish species under the Survey definition and, therefore, occurs in both the sport and nonsport fish species lists.

Fish Classes Present

Respondents were requested to list each fish species present and whether they were considered as sport, sport anadromous, commercial, nonsport, nonsport anadromous, nonsport endangered/threatened, or nonsport species of special concern (Table 2).

The results of the analysis of fish class distribution for "all streams" indicate that sport fish species are present in 72.6% of the Nation's waters, with anadromous sport species (such as salmon) present in 10.6%. Commercial species are found in 16.9% of "all streams." Commercial species can include both sport and nonsport fishes under the Survey definition because many states allow commercial fishing (i.e., fishing for profit) for both types of fish.

Nonsport fish species are estimated to occur in 68.1% of the Nation's waters. Nonsport anadromous species (e.g., shad) are present in approximately 2.1% of the streams, indicating that nonsport anadromous species are not widely distributed. Threatened and endangered species and species designated by the State as being of special concern are present in 0.8% and 2.4% of "all stream" miles, respectively. It should be noted that endangered and threatened species in this Survey included only species listed by the FWS under the Endangered Species Act. States are not responsible for sampling Federally-listed endangered species. State-designated threatened and endangered species, if different from the Federal species, are grouped as species of special concern. It was assumed, prior to the Survey, that these species would be nonsport fish under the Survey definition. However, many of the salmonid or trout species of State concern in the western United States are also sport fish. For example, Colorado River basin States classify the Colorado River cutthroat trout (Salmo clarki pleuriticus) as both a game fish and a threatened species.

Twenty-one percent of "all streams" are classified as containing "no fish." The category "no fish" is rarely found in perennial streams (1.9%). The difference in the "no fish" distribution is due largely to the lack of water in intermittent streams. Data for "perennial streams" show a similar distribution of fish classes as "all streams," except for the "sport fish" and "no fish" categories. "Sport fish" occur in 65.9% of "perennial streams" miles, a difference of approximately 7.0% from the "all streams" value.

Reach Use by Fish Class and Activity

Species are not reported individually with respect to reach use in this report. Rather, they are segregated by the major fish classes of sport and

Table 2. Occurrence of fish by class in the Nation's waters.[a]

Fish Class	All Streams		Perennial Streams	
	Stream Miles	Percentage	Stream Miles	Percentage
Sport Fish	701,780	72.6	636,260	65.9
Anadromous sport fish	102,145	10.6	100,216	10.4
Commercial fish	163,005	16.9	153,377	15.9
Nonsport fish	657,606	68.1	582,895	60.3
Anadromous nonsport fish	20,198	2.1	19,540	2.0
Threatened/Endangered fish	7,720	0.8	7,720	0.8
Species of special concern	23,204	2.4	21,450	2.2
No fish	204,074	21.1	18,298	1.9

[a] Complete Statistics are provided in Appendix D, Table D-2a and b.

nonsport (Table 3). No separate analysis of "perennial streams" was conducted for this category. Use, in this context, refers to biological activity such as the following:

- Year-round resident. A fish species that lives and reproduces in the reach for the entire year.
- Spawns elsewhere. A fish species that lives in the reach but leaves the reach for the purpose of spawning.
- Spawning and hatching. A fish species that lays eggs in the reach. The rest of the life cycle is completed elsewhere.
- Nursery. A fish species that uses the reach as an area for rearing its young.
- Migration route. The fish species uses the reach as a corridor to another area for the purpose of spawning or other life cycle stages.
- Overwintering. The reach is used by the fish species as a wintering area.

Table 3. Estimates of reach use by fish class[a].

Reach Use	Stream Miles	Stream Percentage[b]
Sport Fish		
Year-round resident	633,635	65.6
Spawns elsewhere	96,413	10.0
Spawning/hatching	657,376	68.0
Nursery	653,968	67.7
Migration route	115,184	11.9
Overwintering	640,921	66.3
Nonsport Fish		
Year-round resident	600,946	62.3
Spawns elsewhere	65,553	6.8
Spawning/hatching	616,794	64.0
Nursery	611,247	63.4
Migration route	37,956	3.9
Overwintering	602,539	62.5

[a] Additional statistics are presented in Appendix D, Table D-3a.

[b] Data for "perennial streams" were not analyzed.

In general, reach use by year-round sport and nonsport fish classes is approximately equal to or less than the values for fish class distribution. Sport fish occur year-round in 65.6% of the Nation's waters. This value is exceeded by the number of miles used for spawning and hatching (68.0%) and as overwintering habitat (66.3%).

Nonsport fish are year-round residents in approximately 62.3% of "all streams." Spawning/hatching and nursery areas are represented by 64.0% and 63.4% of all miles, respectively. Nonsport fish overwinter in approximately the same number of miles of streams (62.5%) as nonsport year-round residents (62.3%).

Fish Class Abundance

The abundance of sport and nonsport fish was analyzed both for "all streams" and for "perennial streams" (Table 4). No single quantifiable description of abundance was possible because of the variability that exists in different types of streams in different parts of the Nation and in the types of data collected by each State (Olson and Nystrom 1982). Subjective descriptors of abundance included abundant, common, uncommon, rare, expected, and unknown.

Table 4. National estimates of fish class abundance for "all streams" and "perennial streams"[a].

Fish Class	All Streams		Perennial Streams	
Abundance	Stream Miles	Percentage	Stream Miles	Percentage
Sport Fish				
Abundant	221,694	23.0	208,263	21.6
Common	391,757	40.6	354,024	36.7
Uncommon	52,582	5.5	45,118	4.7
Rare	12,228	1.3	10,196	1.1
Expected	65,619	6.8	59,984	6.2
Nonsport Fish				
Abundant	334,700	35.1	306,363	32.2
Common	303,713	31.9	270,771	28.4
Uncommon	22,344	2.3	13,874	1.5
Rare	4,727	0.5	3,758	0.4
Expected	60,414	6.3	53,286	5.6

[a] See Appendix D, Tables D-4a and b for additional statistics on these fish class abundances.

In "all streams," sport fish are abundant in 23.0% of the stream miles and common in 40.6% Therefore, 63.6% of the Nation's waters are suitable as sport fish habitat. Waters in which sport fish are uncommon or rare are 5.5% and 1.3%, respectively. The respondents expect sport fish species in an additional 6.8% of "all streams."

Nonsport fish in "all streams" are estimated as abundant in 35.1% of the stream miles, common in 31.9%, uncommon in 2.3%, rare in 0.5%, and expected in 6.3%.

"Perennial streams" exhibit similar fish use characteristics as do "all streams," although all values for occurrence and percentages are slightly less. These data suggest that none of the fish classes occur in intermittent streams to any great degree.

Percentage of the Reach that Supports Fish

The analysis of the percentage of the reach that supports fish focused entirely on sport and nonsport classes of fish (Table 5). These results indicate that if fish are present they generally occur in 100% of the reach. Additionally, these results strongly suggest that river reaches are good sampling units regarding the fish community. In the analysis, "all streams" have a greater percentage of streams not supporting fish than do "perennial streams," which may be due to the influence of considering intermittent streams.

Table 5. Estimates of the percentage of each reach that supports sport and nonsport fish classes[a]

	Percentage of Reach that Supports Fish				
	0	1-24	25-49	50-74	75-100
All Streams					
Total Sport Fish (percent)	35.4	3.3	3.8	9.9	47.6
Total Nonsport Fish (percent)	36.0	1.6	1.9	7.6	53.0
Perennial Streams					
Total Sport Fish (percent)	13.3	2.1	3.5	8.5	44.9
Total Nonsport Fish (percent)	12.5	0.9	1.0	6.6	48.9

[a] For additional statistics on estimated percentages, see Appendix D, Tables D-5a and b.

Fish Stocking

Each respondent was requested to provide information on whether or not the species listed are stocked and, if so, the life stage stocked and frequency of stocking. Stocking has often been used as a management tool to provide sufficient numbers of fish for harvest by both commercial and sport fishing interests. It was assumed that, except for experimental programs, stocking was directed at sport fish species (Table 6).

Table 6. National estimates of fish stocking programs for all streams[a].

Life Stage Stocked	Stream Miles	Percentage
All Streams		
Sport Fish		
Eyed eggs	0.0	0.0
Larvae	786	0.08
Fingerlings	78,596	8.1
Subcatchables	15,424	1.6
Catchables	65,186	6.8
More than one life stage	19,520	2.0
Nonsport Fish	0.0	0.0
Perennial Streams		
Sport Fish		
Eyed eggs	0.0	0.0
Larvae	786	0.08
Fingerlings	73,978	7.7
Subcatchables	15,424	1.6
Catchables	64,235	6.7
More than one life stage	19,520	2.0
Nonsport Fish	0.0	0.0

[1] Complete Statistics are given in Appendix D, Table D-6a and b.

Data indicate that present stocking programs rely heavily on fingerling and catchable-size fish. Eight percent of "all streams" and 7.7% of "perennial streams" are stocked with fingerlings. Seven percent of "all streams" and 6.7% of "perennial streams" are stocked with catchable-size fish. All other life stages stocked are less than 2.0%. No major differences in life stage of fish stocked exist between "all streams" and "perennial streams."

Stocking frequencies were divided into three categories: (1) less than once annually; (2) annually; and (3) more than once annually (Table 7). For those waters that are stocked, stocking rarely occurs more frequently than once annually.

Table 7. National estimates of frequency of stocking for maintenance of sport fish species[a].

Stocking Frequency	Stream Miles	Percentage
All Streams		
Sport Fish		
Less than once annually	64,906	6.7
Annually	71,798	7.4
More than once annually	30,040	3.1
Nonsport Fish	0	0.0
Perennial Streams		
Sport Fish		
Less than once annually	63,342	6.6
Annually	68,014	7.0
More than once annually	29,089	3.0
Nonsport Fish	0	0.0

[a] Additional statistics are in Appendix D, Tables D-6a and b.

QUESTION 2 - FISH COMMUNITY SAMPLING EFFORTS

No comparisons were made between quantitative and qualitative fish sampling in "all streams" and "perennial streams." The sampling effort appears to have been approximately equal between quantitative and qualitative methods. Thirty-one percent and 24.6% of the Nation's waters were sampled quantitatively or qualitatively for fish, respectively. Twenty-eight percent had definitely been qualitatively sampled for fish, while 2.9% were thought to have been qualitatively sampled. Respondents reported reaches to be definitely sampled if records existed, and thought to have been sampled if they were part of a river system that had been sampled for fish. Because some of the reaches were sampled by both quantitative and qualitative methods, the total percentage of reaches sampled for fish is approximately 40%.

QUESTION 3 - WATER AS USABLE FISH HABITAT

A determinant of the distribution of fish species is the amount and quality of usable stream habitat. A major component of fish habitat is stream flow (Tennant 1975). Each respondent was asked to indicate the months that the reach had water usable as fish habitat during a normal water year (Figure 5).

Sixty-nine percent of "all streams" contain year-round fish habitat. Streams with no usable habitat during the entire year account for 14.1%. The remainder are waters suitable as habitat during part of the year, with the majority having water during March, April, May, and June, probably the result of spring rains and snowmelt.

QUESTION 4 - FACTORS AND SOURCES ADVERSELY AFFECTING THE FISH COMMUNITY

Each respondent was asked to indicate whether or not the survival, productivity, or use of the reach by the fish community was adversely affected by natural or man-caused conditions. These conditions were grouped into four general categories: water quality, water quantity, usable habitat, and the fish community(Table 8). A list of limiting factors for each category was included. The respondent was also requested to indicate whether the appropriate limiting factors were of major or minor concern.

Table 8. Estimated distribution of major classes of problems adversely affecting fish in the Nation's waters[a].

Class	All Streams		Perennial Streams	
	Stream Miles	Percentage	Stream Miles	Percentage
Water Quality	535,084	56.0	433,987	45.4
Water Quantity	649,102	68.0	387,874	40.6
Usable Habitat	464,885	48.7	387,024	40.5
Fish Community	309,630	32.4	261,018	27.3
Total Adversely Affected	773,330	81.0	508,332	53.3
No Adverse Effects	180,327	18.9	157,831	16.5

[a] Additional statistics are in Appendix D, Tables D-7a and b.

It is estimated that 81.0% of the Nation's waters have fish communities that are adversely affected by a variety of factors. These include water quality in 56.0%, water quantity in 68.0%, usable fish habitat in 48.7%, and problems in the fish community in 32.4% of the Nation's waters.

Data indicate that a smaller number of "perennial stream" miles are adversely affected by all problem categories than are "all stream" miles. The major differences between "perennial streams" and "all streams" are in the miles affected by water quality and quantity problems. These differences are generally attributable to low water flow in intermittent streams.

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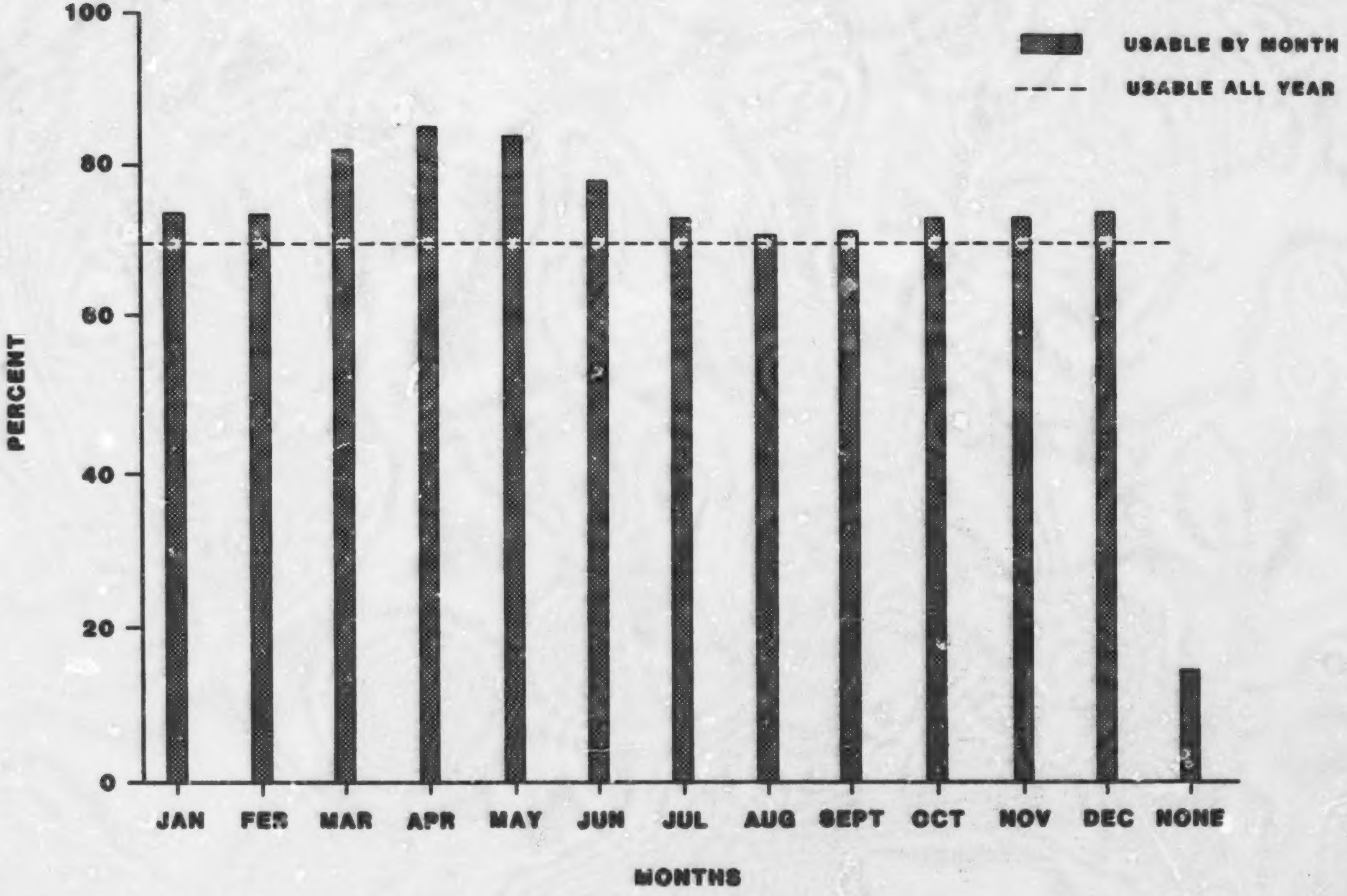

Figure 5. Months of usable habitat.

Because many intermittent streams had not been sampled, the respondents were asked whether or not they definitely knew a problem existed or if the problems were suspected. Results of this analysis show that, in all cases, problems that were definitely known to exist affect a larger percentage of stream miles than those suspected in both "all streams" and "perennial streams" (Table 9).

Table 9. Estimates of the respondents' confidence of the occurrence of major problem classes as percentages of the total stream miles[a].

Class	All Streams Percentage	Perennial Streams Percentage
Water Quality (Definitely)	34.4	26.3
Water Quality (Suspected)	21.6	19.1
Water Quantity (Definitely)	49.2	26.0
Water Quantity (Suspected)	18.8	14.6
Usable Habitat (Definitely)	30.3	24.3
Usable Habitat (Suspected)	18.4	16.2
Fish Community (Definitely)	21.1	17.3
Fish Community (Suspected)	11.3	10.0

[a] Additional statistics are in Appendix D, Tables D-7a and b. The percentages presented in Tables D-7a and b represent the additive total for each class.

Water Quality Factors

Respondents were asked to provide information on water quality factors and sources that adversely affect fish communities (Table 10 and Figure 6). Limiting factors were ranked in order from highest to lowest number of stream miles affected and as a percentage of both "all streams" and "perennial streams."

High turbidity conditions occur in 34.4% of "all streams" and 29.0% of "perennial streams." High turbidity (high suspended solids) directly affects fish survival by clogging gill membranes and indirectly affects survival by smothering fish eggs and covering spawning areas. High turbidity can result in increased water temperature, resulting in decreased levels of dissolved oxygen (Hynes 1970).

High water temperatures occur in 26.2% of "all streams" and 19.1% of "perennial streams." High water temperature can affect both cold-water and warm-water fish species. The generally accepted upper limit for cold-water species, most notably trout, is 20°C, while the upper limit for most warm-water species ranges from 30°C to 35°C (U. S. Environmental Protection Agency 1976). These upper limits are extremes and are for the most part higher than those needed for optimum growth (U. S. Environmental Protection Agency 1976).

Nutrient surpluses occur in 12.5% of "all streams" and 11.3% of "perennial streams." Nutrient surpluses can adversely affect water quality by contributing to excessive growths of algae and aquatic plants. While these

Table 10. Water quality factors affecting the Nation's fisheries[a].

Factor	Stream Miles	Percentage
All Streams		
Turbidity	328,261	34.4
High water temperature	250,187	26.2
Nutrient surplus	119,519	12.5
Toxic substances	93,602	9.8
Dissolved oxygen problem	91,022	9.5
Nutrient deficiency	40,603	4.3
Low water temperature	29,877	3.1
Other	26,685	2.8
pH too acidic	24,793	2.6
Low flow[b]	24,364	2.6
Salinity	17,217	1.8
Sedimentation[b]	14,378	1.5
Siltation[b]	9,644	1.0
Gas supersaturation	5,500	0.6
Intermittent water[b]	4,839	0.5
Herbicides and pesticides[b]	4,356	0.5
pH too basic	3,998	0.4
Channelization[b]	2,937	0.3
Perennial Streams		
Turbidity	276,943	29.0
High water temperature	187,251	19.1
Nutrient surplus	107,434	11.3
Toxic substances	86,549	9.1
Dissolved oxygen problem	75,368	7.9
Nutrient deficiency	37,126	3.9
Low water temperature	27,710	2.9
pH too acidic	23,502	2.5
Other	23,211	2.4
Salinity	14,571	1.5
Sedimentation[b]	14,378	1.5
Siltation[b]	7,889	0.8
Low flow[b]	7,079	0.7
Gas supersaturation	5,500	0.6
Herbicides and pesticides[b]	4,356	0.5
pH too basic	2,475	0.3
Channelization[b]	1,701	0.2
Intermittent water[b]	0	0.0

[a] Additional statistics are in Appendix D, Tables D 8a and b.

[b] These additional categories were developed from clarification by the respondent under the "other" category.

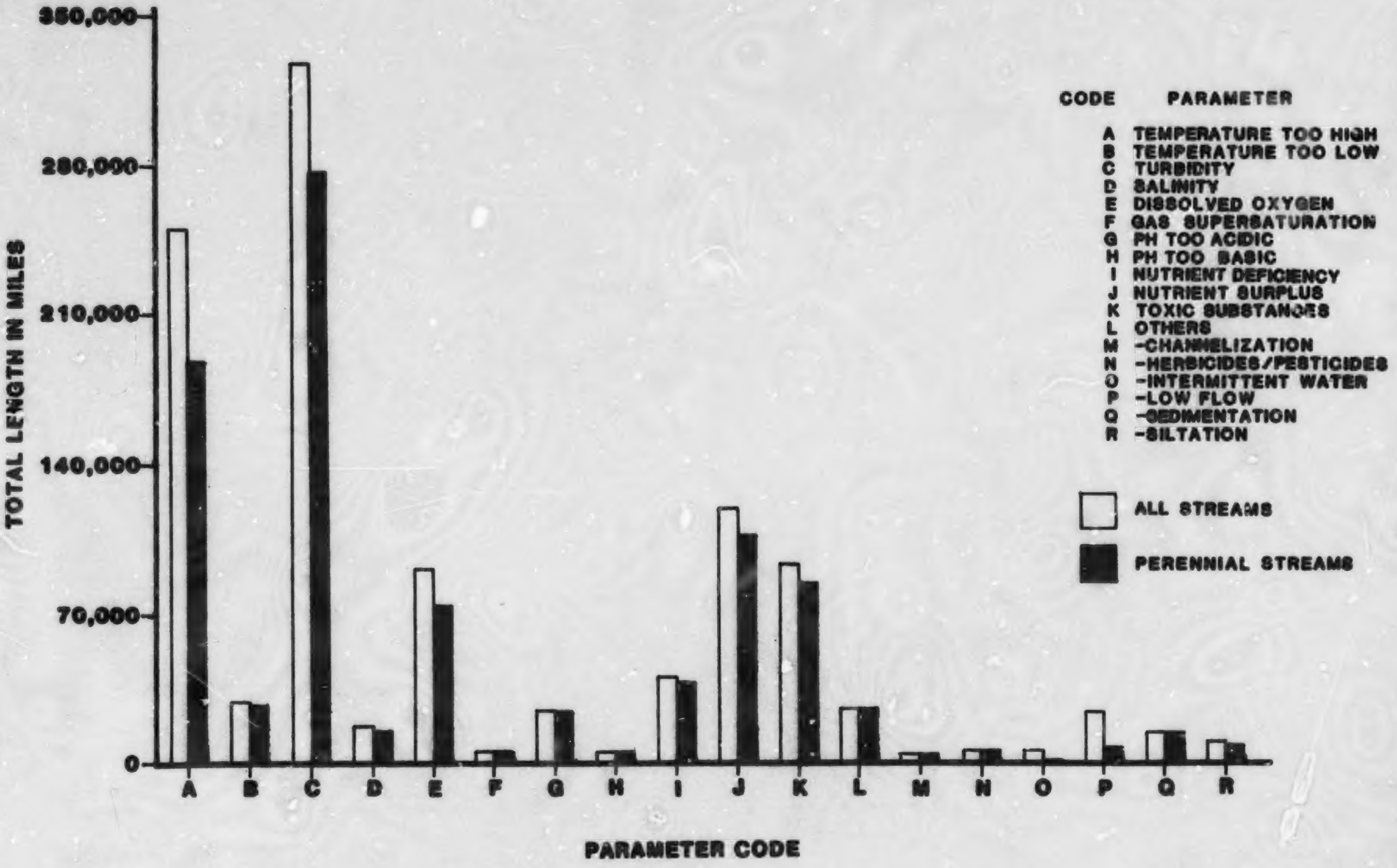

Figure 6. Water quality factors adversely affecting fish communities in the Nation's waters.

organisms themselves may not be detrimental, the increased consumption of dissolved oxygen (DO) during nighttime respiration, coupled with a concurrent decrease in photosynthesis, can greatly reduce the DO available to fish (Hynes 1970). Nutrients in flowing waters that enter natural lakes or impoundments can cause adverse changes in water quality, termed "cultural eutrophication," that result in the accelerated aging of a standing water body.

Toxic substances occur in 9.8% of "all streams" and 9.1% of "perennial streams." Toxic substances affect fish directly by causing death and indirectly by interference with life functions such as reproduction and growth (U. S. Environmental Protection Agency 1976). Toxic substances include heavy metals, such as zinc and mercury, and organic compounds.

Dissolved oxygen problems occur in 9.5% of "all streams" and 7.9% of "perennial streams." Adequate concentrations of dissolved oxygen are important to fish respiration. Dissolved oxygen problems can result from excessive turbidity, high water temperatures, aquatic plant blooms, or decaying organic matter.

Other limiting factors reported, such as nutrient deficiency, low pH, salinity, and gas supersaturation, each occur in less than 5% of "all streams."

Limiting factors are approximately evenly divided between being considered a major and minor concern for both "all streams" and "perennial streams." Turbidity is a major concern in 16.9% and a minor concern in 17.3% of "all streams." High temperatures are a major problem in 13.7% of "all streams" and a minor problem in 12.4%. Toxic substances are a major concern in 3.6% and a minor concern in 6.2% of "all streams." Nutrient surpluses and dissolved oxygen are also relatively equally divided between major and minor concerns. "Perennial streams" reflect the same trend in distribution of concerns between major and minor for all of these limiting factors.

Sources Associated with Water Quality Factors

Probable sources of adverse water quality factors include a wide variety of point and nonpoint sources. Point sources are defined as originating from a pipe or conduit. Nonpoint sources are all diffuse sources, such as runoff from urban, agricultural, and natural areas. Identified pollution sources were ranked in descending order of frequency by stream miles and by the percentage of all streams affected (Table 11 and Figure 7).

The total nonpoint source contribution accounts for the greatest percentage of water quality problems: 38.4% of "all streams" and 34.6% of "perennial streams." Specifically, agricultural activities are identified as causing adverse effects in 29.5% of "all streams" and 26.3% of "perennial streams." Natural sources adversely affect 22.2% of "all streams" and 15.7% percent of "perennial streams."

Table 11. Probable sources of National water quality problems expressed in total stream miles and as percentages of total miles in the Nation's waters[a].

Probable Source	Stream Miles	Percentage
All Streams		
Total nonpoint source contribution	367,244	38.4
Agricultural sources	281,241	29.5
Natural sources	212,389	22.2
Total point source contribution	117,684	12.3
Silviculture/logging	71,736	7.5
Municipal point sources	63,816	6.7
Feed lots	59,947	6.3
Individual sewage disposal	47,823	5.0
Industrial point sources	47,097	4.9
Urban runoff	40,376	4.2
Mining (nonpoint)	31,847	3.3
Combined sewers	29,246	3.1
Construction activity	29,110	3.1
Mining (point)	28,686	3.0
Grazing[b]	21,970	2.3
Other	19,445	2.0
Dam releases	19,314	2.0
Landfill leachate	5,504	0.6
Bedload movement[b]	5,299	0.6
Roads[b]	3,569	0.4
Perennial Streams		
Total nonpoint source contribution	330,840	34.6
Agricultural sources	250,637	26.3
Natural sources	149,893	15.7
Total point source contribution	116,572	12.2
Silviculture/logging	68,981	7.2
Municipal point sources	62,703	6.6
Feed lots	53,775	5.6
Industrial point sources	47,097	4.9
Individual sewage disposal	46,069	4.8
Urban runoff	33,027	4.0
Mining (nonpoint)	30,894	3.2
Combined sewers	29,246	3.1
Construction activity	29,110	3.1
Mining (point)	28,686	3.0
Grazing[b]	19,515	2.0
Dam releases	19,314	2.0
Other	18,524	1.9
Landfill leachate	5,504	0.6
Bedload movement[b]	5,299	0.6
Roads[b]	3,569	0.4

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[a] Additional statistics are in Appendix D, Tables D-10a and b.

[b] These additional categories were developed from clarification by the respondents under the "Other" category.

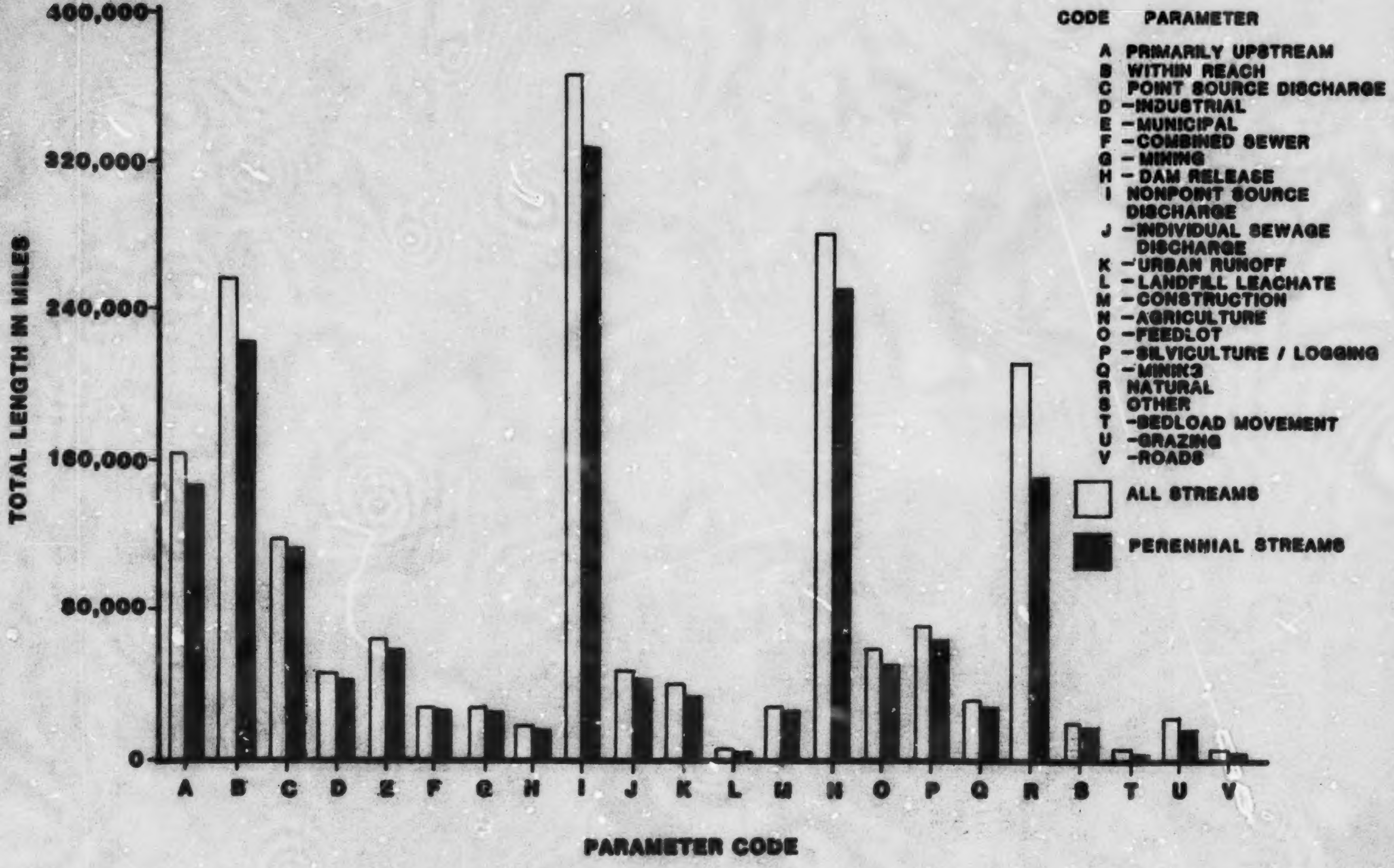

Figure 7. Probable sources of water quality factors adversely affecting fish communities in the Nation's waters.

Although point sources are located on, or have the potential to affect, only about 20% of the Nation's waters, the survey found that over 12.3% of "all waters" are adversely affected by total point source contribution. Specifically, municipal sources were found to adversely affect 6.7% of the waters and industrial sources were found in 4.9%. Other identified pollution sources each account for less than 8% of the sources of adverse water quality factors in the Nation's waters.

It is estimated that nonpoint sources of pollution are considered a major concern in 18.9% and a minor concern in 15.1% of "all streams." Agricultural sources are ranked as a major concern in 17.3% and a minor concern in 12.1% of the Nation's waters. Natural causes rank as a major concern in 14.2% and as a minor concern in 7.9% of the Nation's waters. Point source discharges are a major concern in 5.0% and a minor concern in 5.6% of the Nation's waters. The pattern of major and minor concerns was similar for "perennial streams."

Water Quantity Factors

Each respondent was requested to indicate whether water quantity was a limiting factor adversely affecting the fish community. The water quantity factors most frequently associated with adverse effects on the fish community in "all streams" are below optimum flows, occasional low flows, and excessive flow fluctuations (Table 12 and Figure 8). Below optimum flows occur in 31.5% of "all streams" and 19.7% of "perennial streams." Occasional low flows occur in 22.6% of "all streams" and 18.7% of "perennial streams." Excessive flow fluctuations occur in 16.6% of "all streams" and 12.4% of "perennial streams." All other limiting flow factors, such as above optimum flows and loss of flushing flows, each occur in less than 10% of both "all streams" and "perennial streams."

The major difference between "all streams" and "perennial streams" is the magnitude of adverse water quantity factors. All water quantity problems and, especially, below optimum flows, occur in fewer "perennial streams" than in the "all streams" category. This is because of the influence of including intermittent streams in the "all streams" category.

Water quantity factors were also analyzed in the context of being a major or minor problem. Data indicate that below optimum flows are rated as a major problem in 22.8% and as a minor problem in 8.6% of "all streams." Occasional low flows are rated as a major problem in 9.0% and a minor problem in 13.5% of "all streams." Excessive flow fluctuations are identified more often as a major problem, 11.5%, versus 5.1% as a minor problem in "all streams." Water quantity limitations in intermittent and dry streams rated as major problems in 9.6% and 5.1% of "all streams," respectively, as compared to rating as minor concerns in 0.07% and 0.01%, respectively. Other water quantity factors are rated as major and minor concerns in 1% or less of "all streams." "Perennial streams" follow the same pattern.

Sources Associated with Water Quantity Factors

Each respondent was requested to indicate the probable sources of water quantity factors adversely affecting the reaches selected in the Survey (Table 13 and Figure 9). The Survey results indicate that in

Table 12. Water quantity factors adversely affecting the Nation's fish communities[a].

Factor	Stream Miles	Percentage
All Streams		
Below optimum flows	300,370	31.5
Occasional low flows	215,945	22.6
Excessive flow fluctuations	158,874	16.6
Intermittent[b]	92,562	9.7
Dry[b]	49,403	5.2
Other	43,465	4.6
Above optimum flows	29,354	3.1
Loss of flushing flows	13,431	1.4
Dewatered[b]	7,462	0.8
Low flows[b]	7,384	0.8
Perennial Streams		
Below optimum flows	187,979	19.7
Occasional low flows	178,676	18.7
Excessive flow fluctuations	118,402	12.4
Above optimum flows	27,845	2.9
Intermittent[b]	17,203	1.8
Loss of flushing flows	13,431	1.4
Other	12,413	1.3
Low flows[b]	5,944	0.6
Dewatered[b]	4,968	0.5
Dry[b]	2,788	0.3

[a] Additional statistics are in Appendix D, Tables D-12a and b.

[b] These additional categories were developed from clarification by the respondent under the "Other" category.

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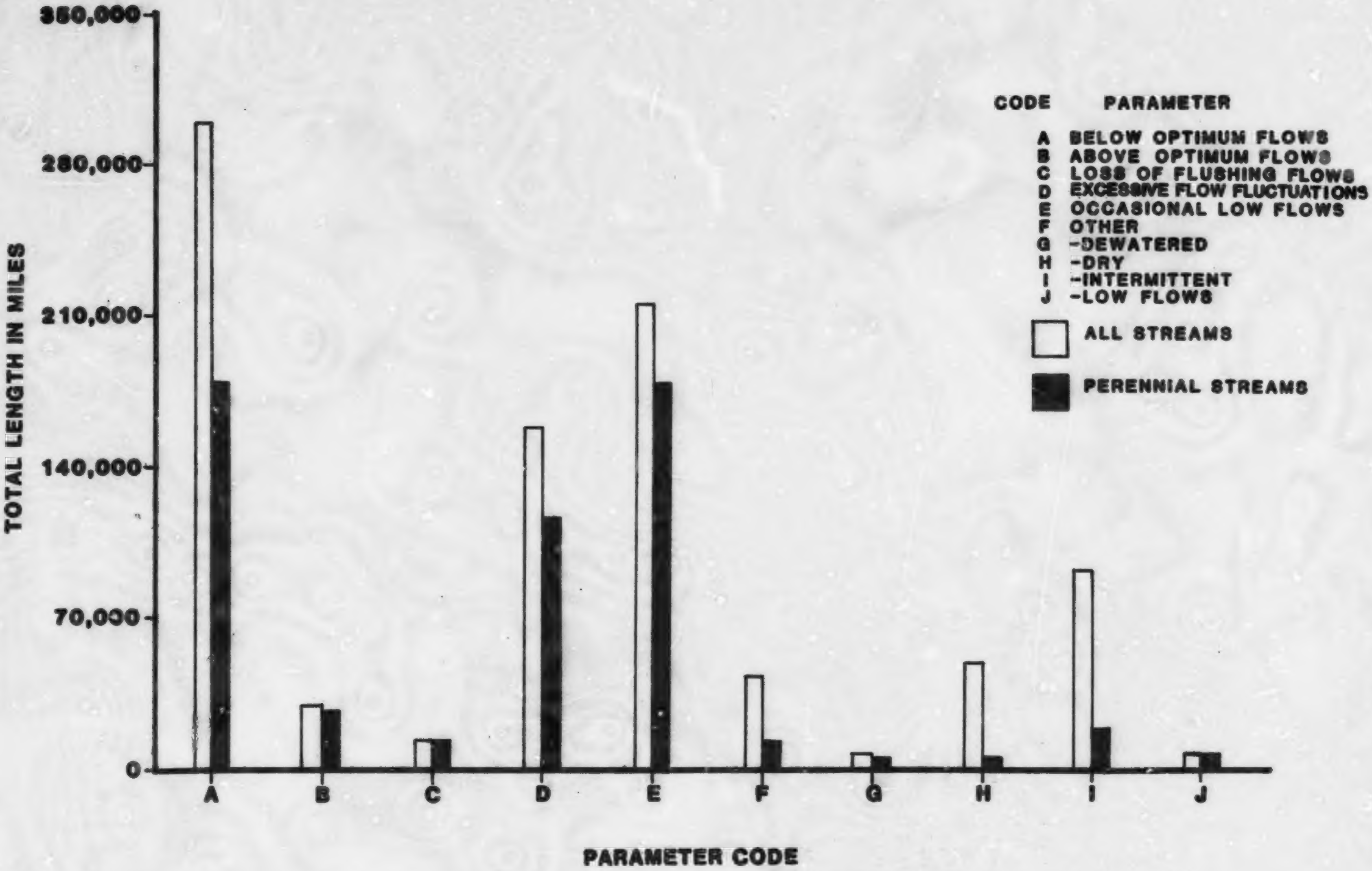

Figure 8. Water quantity factors adversely affecting fish communities in the Nation's waters.

Table 13. Sources of water quantity problems adversely affecting the Nation's waters[a].

Source	Stream Miles	Percentage
All Streams		
Natural conditions	477,791	50.1
Diversions (agricultural)	130,223	13.6
Dam(s) (water storage)	32,901	3.5
Dam(s) (flood control)	28,002	2.9
Dam(s) (power)	24,821	2.6
Other	18,851	2.0
Diversions (municipal)	10,694	1.1
Channelization[b]	10,629	1.1
Floods/low flows[b]	10,527	1.1
Irrigation[b]	8,897	0.9
Logging[b]	6,271	0.7
Ditches[b]	5,335	0.6
Diversions (industrial)	3,292	0.3
Perennial Streams		
Natural conditions	245,678	25.7
Diversions (agricultural)	104,659	11.0
Dam(s) (water storage)	30,817	3.2
Dam(s) (flood control)	26,899	2.8
Dam(s) (power)	24,821	2.6
Other	16,279	1.7
Diversions (municipal)	10,694	1.1
Channelization[b]	10,178	1.1
Floods/low flows[b]	8,773	0.9
Irrigation[b]	6,387	0.7
Ditches[b]	5,335	0.6
Logging[b]	4,408	0.5
Diversions (industrial)	3,292	0.3

[a] Additional statistics are in Appendix D. Tables D-14a and b.

[b] These additional categories were developed from clarification by the respondents under the "Other" category

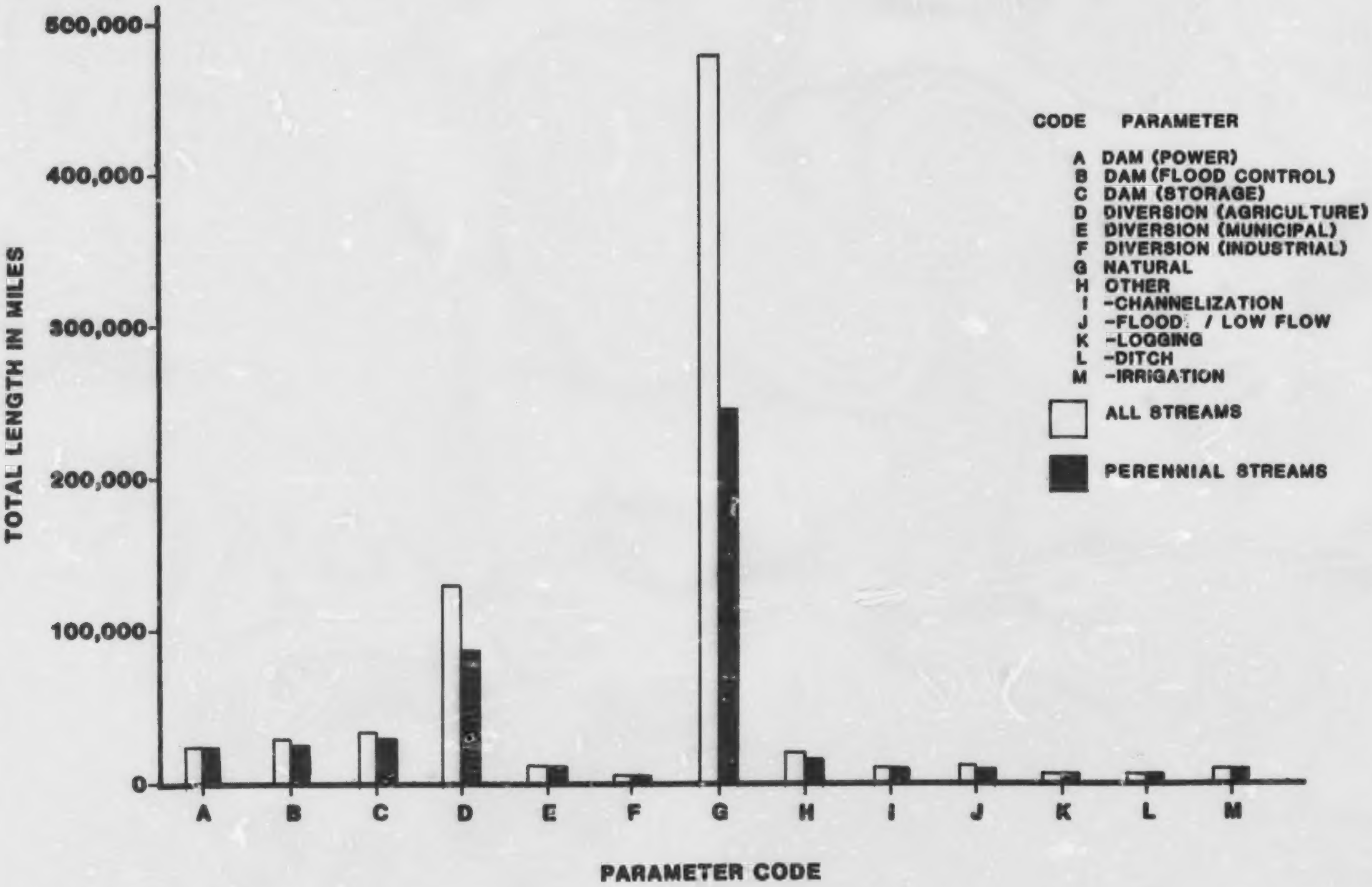

Figure 9. Probable sources of water quantity factors adversely affecting fish communities in the Nation's waters.

natural causes are the principal source associated with water quantity factors. Agricultural diversions are also a principal source. Natural conditions adversely affect the quantity of water in 50.1% of "all streams" and 25.7% of "perennial streams." Agricultural diversions have adverse effects in 13.6% of "all streams" and 11.0% of "perennial streams." All other sources each occur in less than 4% of "all streams."

The sources of water quantity problems in "perennial streams" occur in the same order of importance as in "all streams," but at a decreased magnitude. This is especially true for natural conditions, which occur in approximately one-half as many miles for "perennial streams" as for "all streams." Natural conditions, the largest overall contributor to the lack of water as fish habitat, is rated as a major concern in 37.7% and a minor concern in 12.4% of "all stream" miles. Agricultural diversions are major concerns in 8.2% of "all stream" miles and minor concerns in 5.4%.

Usable Habitat Factors

Each respondent was requested to indicate whether habitat was limiting the use of the reach by the fish community (Table 14 and Figure 10). Odum (1971) states that: "The habitat of an organism is the place where it lives or the place where one would go to find it. Habitat may also refer to the place occupied by an entire community."

Four principal habitat factors were found to adversely affect the fish community: overall adult/juvenile habitat (40.4% of "all streams"), overall egg/larvae habitat (28.3% of "all streams"), specific habitat-pools (20.7% of "all streams"), and specific habitat-gravel substrate (16.4% of "all streams"). Pools or fish resting areas are generally thought of as adult/juvenile habitat. Gravel substrate is a necessary component for successful spawning of most stream fishes.

Overhead cover (e.g., trees over the water) and riffles (i.e., shallow rapids) are protective and food producing components of the aquatic system. Overhead cover is inadequate in 14.1% of "all streams" and riffles are inadequate in 13.5% of "all streams." The lack of these habitat components can add to predation, high water temperatures, and decreased food availability (Hynes 1970).

Results for "perennial streams" parallel those for "all streams," except for the magnitude of each limiting factor. In all cases, the limitations of these characteristics affected a smaller length and percentage of "perennial stream" miles than "all streams" miles.

Inadequate adult and juvenile habitat is ranked as a major concern in 22.7% and as a minor concern in 16.3% of "all stream" miles. Inadequate egg and larvae habitat follows a similar pattern, ranking as a major concern in 15.5% and as a minor concern in 11.3% of "all stream" miles. Lack of pools and gravel substrate have similar results. All other limiting habitat factors are equally divided between major and minor concerns. Results for "perennial streams" parallel those for "all streams."

Table 14. Habitat factors adversely affecting the Nation's fisheries[a].

Factor	Stream Miles	Percentage
All Streams		
Adult/juvenile habitat	385,394	40.4
Egg/larvae habitat	269,972	28.3
Pools	197,533	20.7
Gravels	156,540	16.4
Overhead cover	134,232	14.1
Riffles	129,090	13.5
Undercut banks	103,692	10.9
Plants/plant debris	62,412	6.5
Snags	61,866	6.5
Boulders	51,768	5.4
Other	31,374	3.3
Intermittent flow[b]	11,498	1.2
Low flows[b]	3,434	0.4
Perennial Streams		
Adult/juvenile habitat	324,954	34.0
Egg/larvae habitat	243,822	25.5
Pools	162,276	17.0
Gravels	143,049	15.0
Overhead cover	116,608	12.2
Riffles	110,125	11.5
Undercut banks	91,158	9.5
Plants/plant debris	54,757	5.7
Snags	51,242	5.4
Boulders	46,889	4.9
Other	25,317	2.7
Intermittent flow[b]	2,807	0.3
Low flows[b]	1,310	0.1

[a] Additional statistics are in Appendix D, Tables D-16a and b.

[b] These additional categories were developed from clarification by the respondents under the "Other" category.

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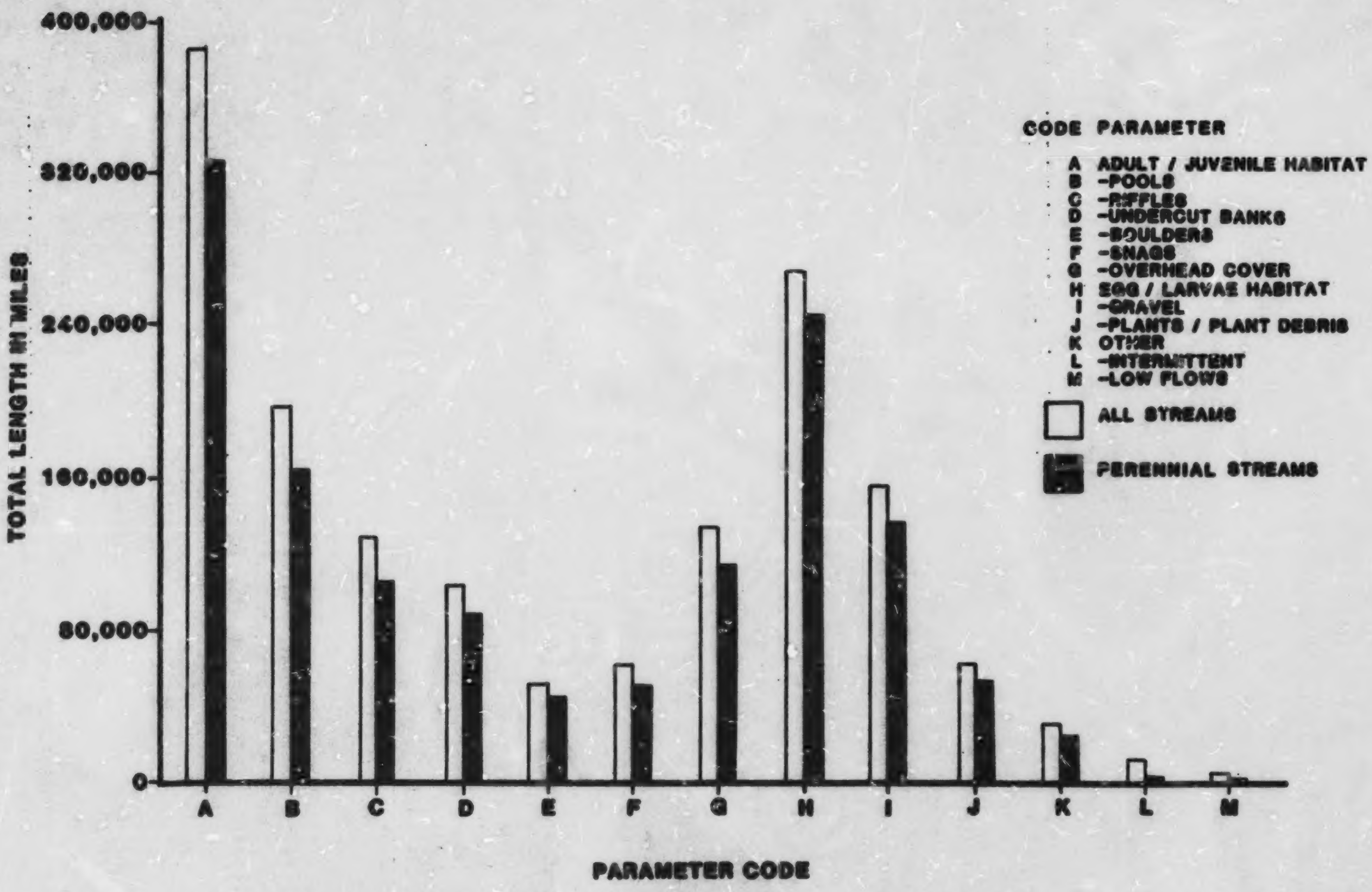

Figure 10. Usable habitat factors adversely affecting fish communities in the Nation's waters.

Sources Associated with Usable Habitat Factors

Respondents were requested to provide information on the probable sources of factors affecting usable habitat within the Nation's waters. Information on the probable sources of usable habitat problems can provide insight into methods to minimize and correct these problems. The Survey results are presented in Table 15 and Figure 11. Excessive siltation occurs in 27.9% of "all streams" and 24.8% of "perennial streams." Bank erosion and sloughing occur in 18.1% of "all streams" and 16.0% of "perennial streams." Natural causes occur in 17.6% of "all streams" and 13.4% of "perennial streams." Channelization occurs in 11.6% of "all streams" and 10.3% of "perennial streams." All other factors limiting usable habitat, such as channel modifications other than channelization and migration blockages, each occur in less than 5.0% of "all streams" and "perennial streams."

Excessive siltation is ranked as a major concern in 17.9% and a minor concern in 9.9% of "all streams." Bank erosion and sloughing are ranked approximately equally as a major concern (10.0%) and as a minor concern (8.2%) in "all streams." Natural causes are a major concern in 10.6% of "all streams," and a minor concern in 6.8%. Channelization is a major concern in 7.8% of "all streams" versus a minor concern in 3.8%. Other channel modifications and all other sources are generally ranked as minor concerns. Data for "perennial streams" follow the same pattern as for "all streams."

Fish Community Factors

The respondents were requested to indicate whether problems within the fish community were limiting fishery potential (Table 16 and Figure 12). Fish kills and contamination of fish flesh are the most prevalent factors, with fish kills affecting 15.3% and contamination of fish flesh affecting 9.4% of "all streams." All other factors, such as diseases, parasites, overharvest, and poaching, are each estimated to occur in less than 4.0% of "all streams."

Data for "perennial streams" indicate that fish kills and contamination of fish flesh occur in 12.1% and 8.6% of these streams, respectively. All other factors occur in less than 4.0% of all "perennial stream" miles.

The degree of concern expressed by the respondents about each of these limiting features suggests that these fish community problems are not significant on a National basis. Fish kills are more often considered a minor problem (8.4%) than a major one (6.9%) in "all streams." Contamination also follows this pattern. All other factors are considered minor problems in "all streams." Results for "perennial streams" are similar to those for "all streams" for all limiting factors.

Sources Associated with Fish Community Factors

Each respondent was requested to indicate the probable sources of limiting factors occurring in the fish community (Table 17 and Figure 13). Three sources were found to contribute the most to the problem: natural causes, pesticides, and other noxious or toxic substances.

Table 15. Sources of factors adversely affecting the Nation's fishery habitat[a].

Source	Stream Miles	Percentage
All Streams		
Excessive siltation	265,169	27.9
Bank erosion/sloughing	172,960	18.1
Natural causes	167,308	17.6
Channelization	110,352	11.6
Other channel modifications	46,046	4.8
Migration blockage	45,007	4.7
Other	43,306	4.6
Bank encroachment[b]	12,776	1.3
Low flows[b]	4,182	0.4
Silviculture[b]	4,117	0.4
Grazing[b]	3,351	0.4
Perennial Streams		
Excessive siltation	236,094	24.8
Bank erosion/sloughing	152,405	16.0
Natural causes	127,781	13.4
Channelization	98,068	10.3
Other channel modifications	45,396	4.8
Other	41,080	4.3
Migration blockage	39,744	4.2
Bank encroachment[b]	8,975	0.9
Silviculture[b]	4,117	0.4
Grazing[b]	1,678	0.2
Low flows[b]	1,470	0.2

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[a] Additional statistics are in Appendix D, Tables D-18a and b.

[b] These additional categories were developed from clarification by the respondents under the "Other" category.

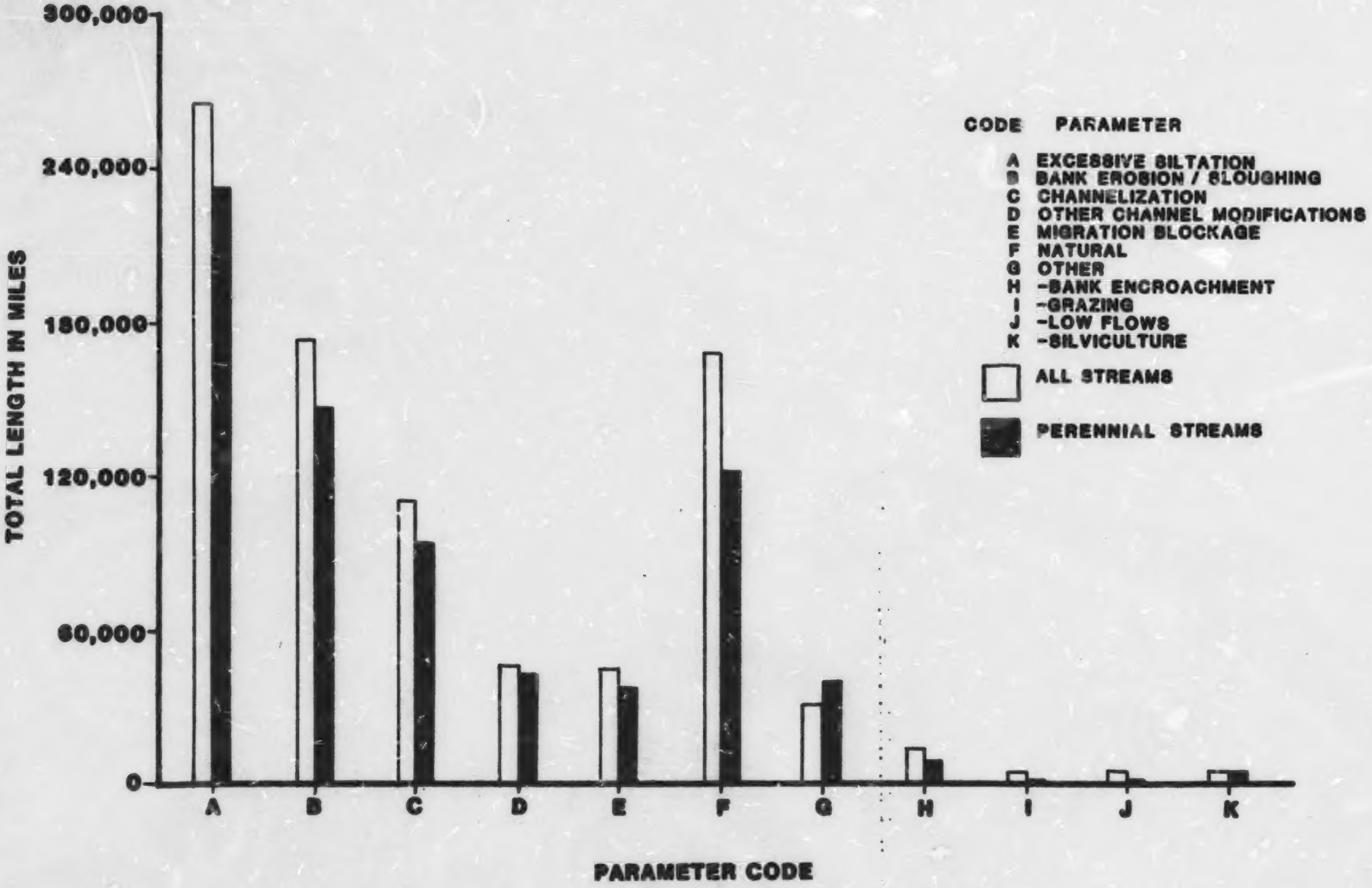

Figure 11. Probable sources of usable habitat factors adversely affecting fish communities in the Nation's waters.

Table 16. Limiting factors adversely affecting the Nation's fish communities[a]

Factor	Stream Miles	Percentage
All Streams		
Fish kills	115,435	12.1
Contamination	81,927	8.6
Overharvest	35,566	3.7
Poaching	28,145	2.9
Diseases/parasites	21,873	2.3
Fish stocking	19,350	2.0
Other	18,063	1.9
Habitat[b]	14,213	1.5
Underharvest	12,714	1.3
Competition[b]	10,836	1.1
Water quality[b]	5,879	0.6
Tumors/lesions	5,101	0.5
Low flow[b]	3,194	0.3
Small channel capacity[b]	1,657	0.2
Perennial Streams		
Fish kills	145,827	15.3
Contamination	90,187	9.[illegible]
Overharvest	35,566	3.7
Poaching	29,447	3.1
Diseases/parasites	24,530	2.5
Other	20,880	2.2
Fish stocking	19,350	2.0
Habitat	15,834	1.6
Underharvest	13,671	1.4
Competition[b]	10,836	1.1
Water quality[b]	5,879	0.6
Tumors/lesions	5,101	0.5
Low flow[b]	5,009	0.5
Small channel capacity[b]	3,702	0.4

[a] Additional statistics are in Appendix D, Tables D-20 and 21, a and b.

[b] These additional categories were developed from clarification by the respondents under the "Other" category.

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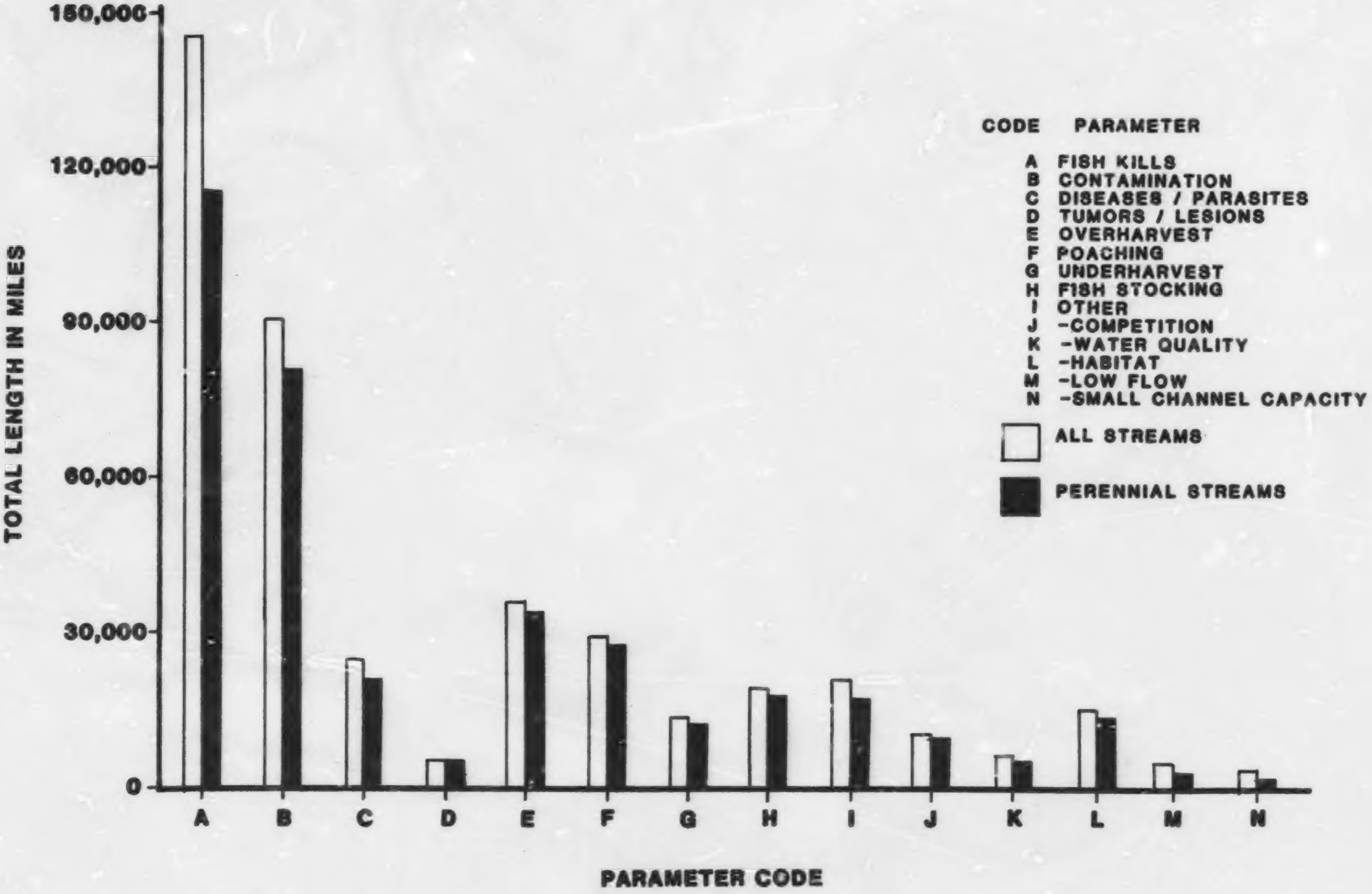

Figure 12. Limiting factors adversely affecting fish communities in the Nation's waters.

Table 17. Sources of limiting factors adversely affecting the Nation's fish communities.[a]

Source	Stream Miles	Percentage
All Streams		
Heavy metals	20,334	2.1
Pesticides	72,586	7.5
Other noxious/toxic substances	68,945	7.2
Crowding	25,678	2.7
Other stress	33,868	3.5
Natural	132,415	13.8
Other	41,794	4.4
Angling pressure[b]	6,633	0.7
Dewatering[b]	6,876	0.7
Humans[b]	8,741	0.9
Lack of access[b]	6,094	0.6
Municipal effluent[b]	7,144	0.7
Perennial Streams		
Heavy metals	19,382	2.0
Pesticides	64,670	6.7
Other noxious/toxic substances	64,633	6.7
Crowding	21,962	2.3
Other stress	30,258	3.2
Natural	98,662	10.3
Other	37,873	3.9
Angling pressure[b]	6,633	0.7
Dewatering[b]	6,876	0.7
Humans[b]	8,741	0.9
Lack of access[b]	6,094	0.6
Municipal effluent[b]	7,144	0.7

[a] Additional statistics are in Appendix D, Tables D-22 and 23, a and b.
[b] These additional categories were developed from clarification by the respondents under the "Other" category.

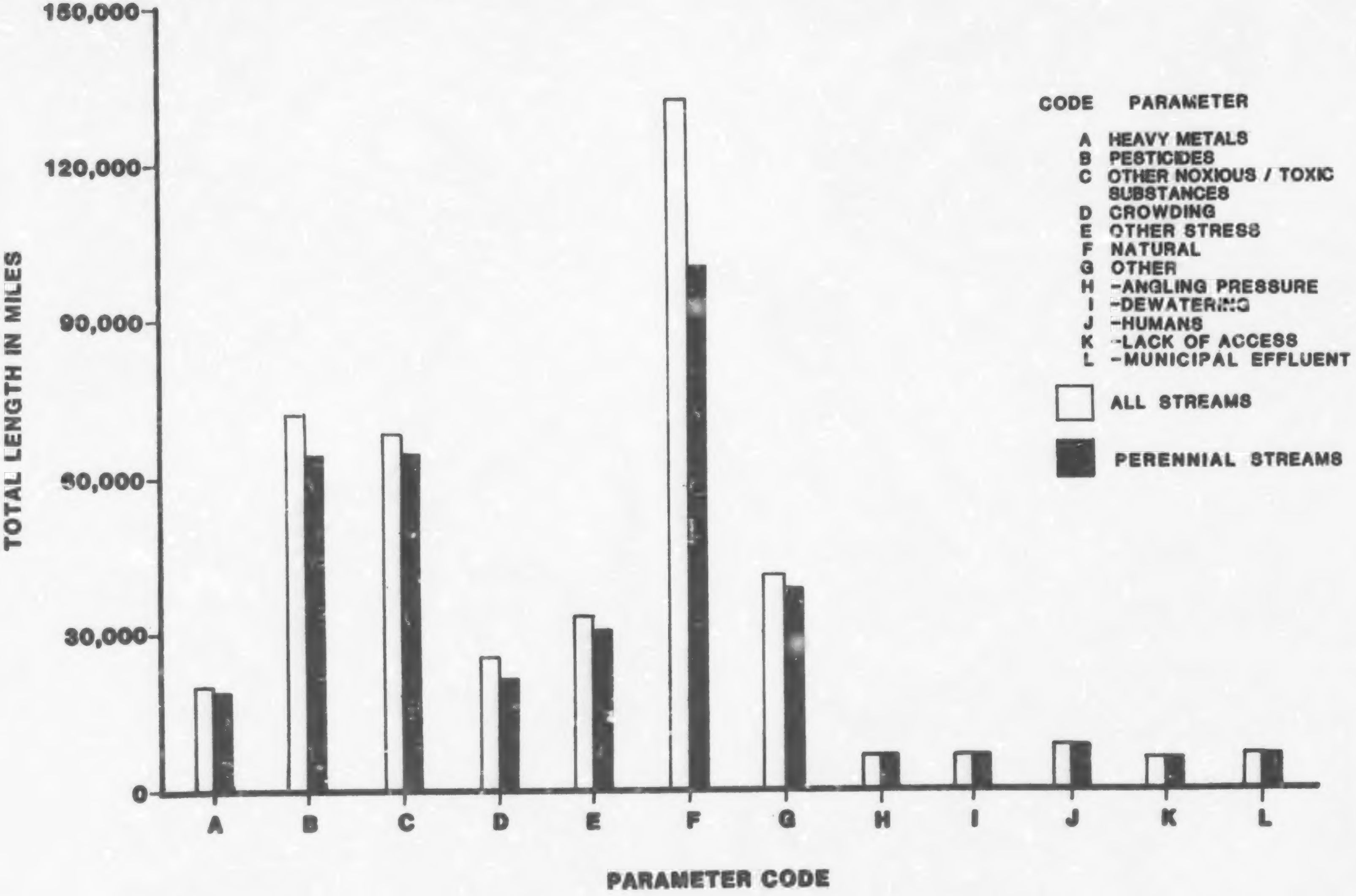

Figure 13. Probable sources of limiting factors adversely affecting fish communities in the Nation's waters.

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The results for "all streams" show that natural causes (e.g., low flows that cause water temperatures to rise above lethal limits) occur in almost twice as many miles (13.8%) as the next ranked source, pesticides. Pesticides are a probable source in 7.6% of the Nation's waters. Other noxious or toxic substances are limiting in 7.2% of the Nation's waters.

Natural causes are the greatest source of limiting factors in fish communities in "perennial streams," occurring in 10.3%, followed by pesticides and other noxious or toxic substances. This is similar to the "all streams" analysis. All other sources occur with the same general distribution as in "all streams."

Natural causes are considered a major concern in 9.7% and a minor concern in 4.1% of "all streams." Pesticides and other noxious or toxic substances are fairly evenly split between being considered a major and a minor concern. Data for "perennial streams" follow the same pattern.

STATUS OF THE NATION'S WATERS AS REFLECTED BY THE FISH COMMUNITIES

Respondents ranked the status of each reach with respect to its ability to support fish, particularly sport fish and species of special concern. The rankings were from 0 to 5, with 0 defined as no ability to support any fish population and 5 defined as the maximum ability to support populations of sport fish and species of special concern. The ranks from 1 to 4 represented intermediate positions. This ranking was made after the respondents had considered all potential limiting factors, and their possible sources, affecting the ability of the stream to support fish. Respondents ranked the current condition of the reach (Question 5) and the condition 5 years ago (Question 6). They were then asked to speculate on the condition 5 years in the future if present trends in the reach continued (Question 7), and the likely condition 5 years in the future if the man-caused limiting factors were controlled or eliminated (Question 8).

Question 5 - Present Status of the Nation's Waters as Reflected by the Fish Communities

Each respondent was requested to rank the current condition of each reach using the evaluation criteria previously described. Results of the analysis of the current condition of each reach are presented in Table 18. For the category "all streams," 23.1% of the streams have a 0 ranking. This compares with 3.1% of "perennial streams." Ten percent of "all streams" are ranked as 1 (ability to support a nonsport fish population only), compared to 5.2% of "perennial streams." An estimated 21% of "all streams" are ranked as 2 (minimally able to support sport fish populations, species of special concern, or both); 17.2% of the "perennial streams" are ranked 2. Forty-six percent of "all streams" are ranked as a 3, 4, or 5 compared to 44% of "perennial streams." A small percentage of streams (3.9% of both "all streams" and "perennial streams") are able to support sport fish, species of special concern, or both at a maximum level (rank 5). The major differences between the "all streams" and "perennial streams" categories are the percentage of streams with no ability to support fish (rank 0) and streams with the ability to support only nonsport species of fish (rank 1).

Table 18. Current condition of the Nation's waters related to their ability to support fish[a].

Current Condition	Stream Length (miles)	Percentage
All Streams		
0	221,029	23.1
1	92,482	9.7
2	203,157	21.3
3	239,556	25.1
4	161,922	17.0
5	37,009	3.9
Perennial Streams		
0	29,872	3.1
1	49,311	5.2
2	166,306	17.3
3	228,660	23.9
4	156,239	16.4
5	36,130	3.8

[a] Additional comparison statistics are in Appendix D, Tables D-24a and b.

Question 6 - Past and Present Trends by Comparing Status of the Nation's Fish Communities.

Estimates were made to determine the ability of the Nation's waters to support fish communities 5 years ago (Table 19). Past condition was then compared with present conditions to determine changes in the ability of the Nation's waters to support fish populations (Figure 14). The diagonal line on the figure represents no change in rank. Above the diagonal line conditions have degraded during the past 5 years while below the diagonal line conditions have improved. For example, 15,000 stream miles have improved from a ranking of 2, 5 years ago, to a current ranking of 3. Overall, 91% of the streams kept the same rank, 4% have improved rank, and 5% have degraded rank.

Question 7 - Future Conditions if Present Trends in the Reach Continue

Respondents were asked to speculate on the condition of the reach in 5 years if present trends in the reach continue (Table 20). The results for both the "all stream" and "perennial stream" categories indicate that the respondents believe the ability of the Nation's waters to support sport fish species, species of special concern, or both, may decline in the next 5

Table 19. Past condition of the Nation's waters related to their ability to support fish.[a]

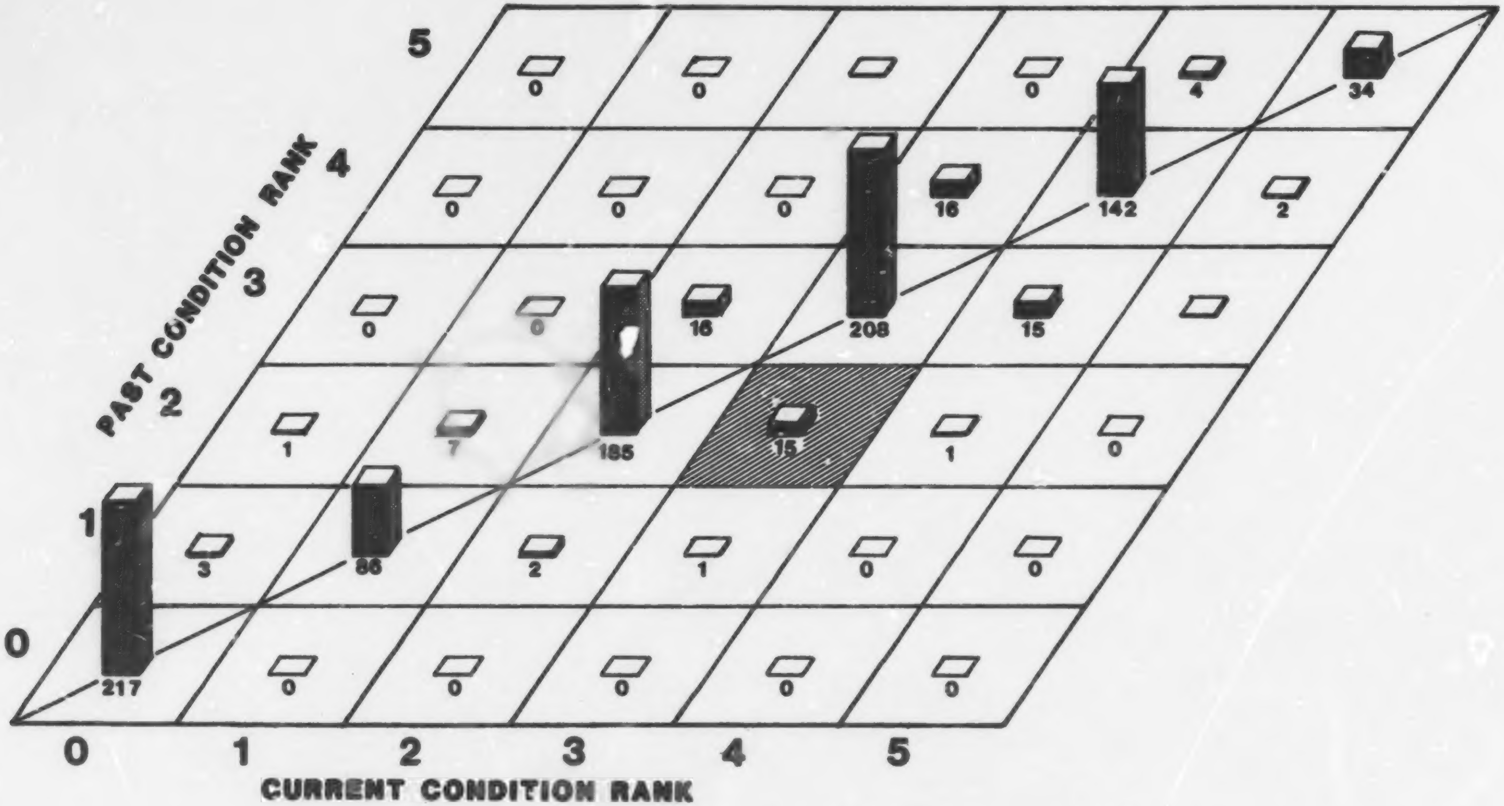
Past Condition	Stream Length (miles)	Percentage
All Streams		
0	216,853	22.7
1	91,757	9.6
2	207,999	21.8
3	239,121	25.0
4	160,348	16.8
5	39,078	4.1
Perennial Streams		
0	29,872	3.1
1	48,790	5.1
2	170,066	17.8
3	224,024	23.4
4	155,567	16.3
5	38,199	4.0

[a] See Appendix D, Tables D-24a and b for additional statistics.

years (Figure 15). In this figure, improvement is above the diagonal while degradation is below. For example, 41,000 miles of stream will degrade from an intermediate ability to support sport fish (rank 3) to a minimal ability to support sport fish (rank 2). Streams that will not support any fish will increase from 23.1% to 24.0% of "all streams" and from 3.1% to 3.5% of "perennial streams." Streams with a rank of 1 (only support non-sport fish species) will increase in "all streams" from 9.7% to 12.0%. In "perennial streams," rank 1 streams will increase from 5.2% to 7.4%. Streams with an intermediate ability to support fish (rank 3) will decline from 25.1% to 22.2% of "all streams" and 23.9% to 21.1% of "perennial streams."

Question 8 - Future Conditions with Controls on Man-Caused Limiting Factors

The Survey results indicate that in the view of the respondents there could be improvements in the Nation's waters over current and projected future conditions if man-caused limiting factors were controlled or eliminated (Table 20, previously presented). If the man-caused limiting factors affecting the fish communities are controlled, the number of streams ranked 0, 1, and 2 (those with minimal ability to support fish) would decrease, with a concomitant increase in the number of higher-ranked stream miles.



(All numbers are thousands of stream miles)

NOTE: IN READING THE GRAPH, THE DIAGONAL LINE REPRESENTS NO CHANGE IN STATUS. ABOVE THE DIAGONAL LINE INDICATES DEGRADATION WHILE BELOW THE DIAGONAL LINE SHOWS IMPROVEMENT IN REACH CONDITIONS. FOR EXAMPLE, 15,000 STREAM MILES HAVE IMPROVED FROM RANK 2 TO RANK 3 IN THE PAST 5 YEARS.

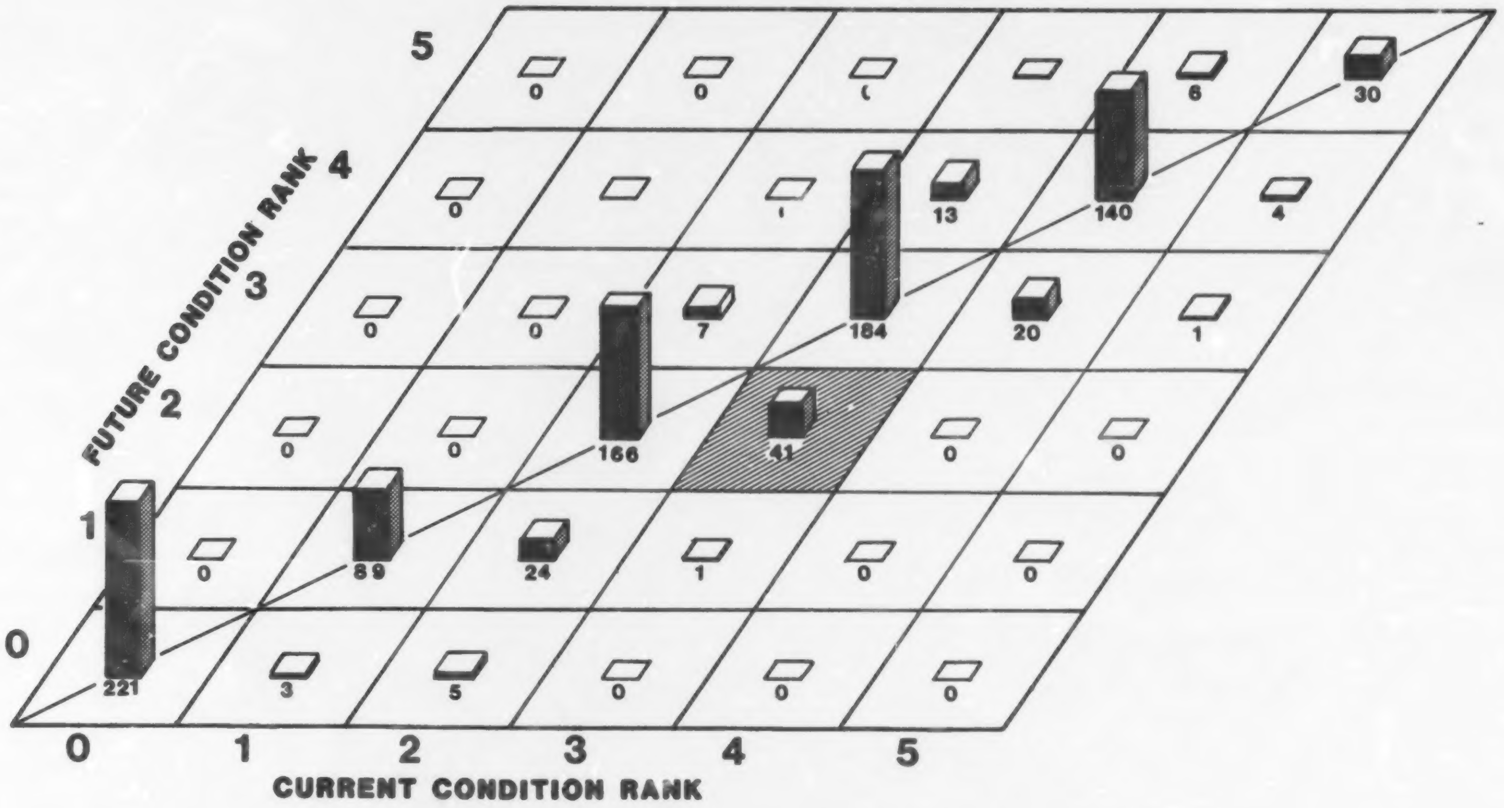
Figure 14. Comparison of current and past reach condition with respect to the ability of the reach to support sport fish.

Table 20. Respondents' speculative assessment of future reach condition without and with controls on man-caused limiting factors.

Future Condition Without Control[a]	Stream Length (miles)	Percentage	Future Condition With Controls	Stream Length (miles)	Percentage
All Streams			All Streams		
0	229,245	24.0	0	119,776	12.8
1	114,628	12.0	1	42,176	4.5
2	206,872	21.6	2	124,019	13.3
3	211,917	22.2	3	255,367	27.4
4	157,038	16.4	4	294,116	31.4
5	36,515	3.8	5	97,251	10.4
Perennial Streams			Perennial Streams		
0	33,270	3.5	0	30,681	3.3
1	70,735	7.4	1	27,239	2.9
2	173,936	18.2	2	90,476	9.7
3	202,264	21.1	3	236,958	25.4
4	151,984	15.9	4	279,815	30.0
5	35,644	3.7	5	92,349	9.9

[a] See Table D-25a and b, Appendix D for additional statistics.

[b] See Tables D-26a and b, Appendix D for additional statistics.



(All numbers are thousands of stream miles)

NOTE: IN READING THE GRAPH, THE DIAGONAL LINE REPRESENTS NO CHANGE IN STATUS. ABOVE THE DIAGONAL LINE INDICATES IMPROVEMENT, WHILE BELOW THE DIAGONAL LINE SHOWS DEGRADATION IN REACH CONDITIONS. FOR EXAMPLE, 41,000 MILES OF STREAM ARE PREDICTED TO DECREASE IN QUALITY FROM RANK 3 TO RANK 2 IN THE NEXT 5 YEARS IF CURRENT TRENDS CONTINUE.

Figure 15. Comparison of current and future reach condition with respect to the ability of the reach to support sport fish.

CHAPTER 4. DISCUSSION

The National Fisheries Survey is significant in that it was the first survey designed to relate the quality of the Nation's waters to the health and viability of the biotic communities dependent on those water resources. The fish community was selected as the best indicator of the biological conditions of the Nation's waters for the following reasons:

> "Fish act as continuous monitors of water quality in contrast to standard sampling and testing programs which fail to identify brief episodes of polluted conditions. Fish generally have long life cycles, so that infrequent fish census may provide more information than more frequent counts of other organisms with shorter life cycles" (National Commission on Water Quality 1975).

The Survey design, the probability structure used to select the sample reaches, the experience level of the respondents, and the high response rate combined to provide reliable estimates of the status of the Nation's waters, their ability to support fish communities, and informed judgment on limiting factors affecting those fish communities.

The number and extent of data analysis were limited for this report by available resources. Further analysis of the data could be conducted. Recommendations for additional analyses are presented in Chapter 5. The following points highlight our initial interpretations of the data:

- Results of the Survey show that the two most prevalent sport fish species, largemouth bass and rainbow trout, respectively occur in 27% and 22% of the Nation's waters. These species are representative of warm-water and cold-water fish communities and are intolerant of poor water quality (Hynes 1970). Both species occupy the top of the aquatic food chain. Their wide distribution suggests that conditions in the majority of the Nation's waters are generally suitable for these two broad fish community types. At least one species of sport fish is present in 73% of the Nation's stream miles. Twenty-one percent of the Nation's total stream miles contain no fish. Many of these streams are intermittent or dry.

- Where nonsport fish occur, they are more abundant than sport fish. Three possible reasons exist for this greater abundance. First, the term nonsport fish encompasses a wide array of primary and intermediate level consumers that are used by sport fish as food. Primary consumers are expected to occur in greater numbers than secondary consumers (Odum 1971). Second, nonsport fish include

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species that are tolerant of less than favorable habitat conditions and, therefore, may exhibit a wider distribution. For example, carp can breathe atmospheric oxygen in order to survive periods of low dissolved oxygen in the water. The third possibility is the Survey definition of sport fish as a fish species with a legal limit set by the State; many States consider some fish species without limits as sport fish.

° The results of the Survey indicate that important components of fish habitat are limiting in almost half of the total stream miles. This condition has implications regarding the ability of the Nation's waters to continue supporting viable fish populations. This must also be considered in the context that "any modification of inland waters which produces displacement of ecosystem structure or function is to be regarded as a degradation of ecological integrity" (Cairns 1978).

° A large portion of the Nation's streams, approximately 46%, are rated fair in terms of their ability to support sport fish populations. About one-third of the Nation's streams fall into the poor category. Many of these latter streams are intermittent and have little potential for improvement. Whether or not these streams can be managed effectively to improve their fisheries depends entirely on the site-specific cause of the adverse factors. Agricultural nonpoint sources appear to influence water quality on more stream miles than any other category of sources. Continued management through increased implementation of erosion controls and agricultural best management practices may be the most effective method of improving stream habitat conditions. These efforts would also contribute to an overall improvement in the Nation's water quality.

° Habitat problems and water quality factors appear to be related. Specifically, there appears to be a direct relationship between loss of adult, juvenile, larval, and egg habitat and excessive siltation and bank erosion. Whether these sources are natural or man-caused was not determined in the Survey. However, Survey responses on water quality indicate that turbidity problems are largely associated with natural and agricultural sources. This is consistent with the Council on Environmental Quality's (CEQ's) Report, Environmental Quality (1981), which states that 50% of the Nation's water quality problems are a function of nonpoint source runoff and that the single largest cause of these problems is agricultural practices.

° The status of the Nation's fisheries has not changed appreciably during the last 5 years. This is consistent with the CEQ's determination that water quality was maintained at a stable level during the 5 years preceding 1981, even though population and other growth pressures increased (Council on Environmental Quality 1981). The CEQ also concluded that evidence of improvement in water quality would not be immediate. The States, through their biennial reports to Congress, agree with this conclusion.

- In 1975, the National Commission on Water Quality estimated the percentage of areas suitable for sport fish populations without exercising best available technologies for eliminating pollution in the Nation's streams. In the 5 regions they examined, the range varied from 20% (Midwest Region) to 90% (Gulf of Alaska). The average National percentage of areas suitable for sport fish populations was 56.3%. The Commission projected that, by 1983, best available technology practices could raise this average percentage figure to 70.6%. If all discharges were eliminated, the average percentage was projected to be 72.6%. These percentages are similar to the National Fisheries Survey estimation that 67% of the Nation's stream miles have at least a minimal ability to support sport fish communities.

- The State fishery biologists responding to this Survey speculate that without control of man-caused sources of limiting factors, a dramatic decrease in the Nation's fish communities could occur in streams whose present capabilities are marginal (rank 3). Higher ranked streams would also be expected to decline in numbers. A commensurate increase in the number of streams that cannot support fish and in streams with a minimal ability to support sport fish would be expected.

- Because management of naturally-caused adverse conditions may be limited, management of man-caused adverse conditions appears to be the key to maintaining, and possibly improving, the status of the Nation's fish communities. The State fishery biologists responding to the Survey speculate that the capability of the Nation's waters to support sport fish could be greatly increased over present conditions if man-caused limiting factors were controlled.

The cooperation of the FWS, the EPA, and the States in the conduct of this project is in the spirit of recommendations by the CEQ Intraagency Task Force. The Task Force was formed in 1977 to assess needs in environmental data and monitoring programs (Council on Environmental Quality 1981). The level of cooperation in this project is a foundation upon which other agencies that are responsible for water quality and fishery quality can build to enhance the overall value and economy of Federal biological monitoring. The overall objective of the Survey was the development of estimates of the biological quality of the Nation's waters, as mandated by the Clean Water Act. This objective has been successfully met.

CHAPTER 5. RECOMMENDATIONS FOR ADDITIONAL ANALYSES

This Survey is the first step in a continuing effort to increase our knowledge of the status of the Nation's waters, including their physical, chemical, and, especially, biological quality. The recommendations presented in this chapter describe several additional statistical analyses that could be performed on the existing Survey data. These analyses would enable a more definitive assessment of the relationships among limiting factors and sources that would further assist in interpretation of the results and formulation of conclusions. Additional analyses would benefit both fishery and water quality managers and planners as they attempt to allocate decreasing resources to areas of greatest need and greatest potential return.

DETERMINATION OF ASSOCIATIONS AMONG FACTORS AND CAUSES

The major area recommended for further analysis is the relationship among factors that adversely affect the Nation's waters and their sources. These analyses would identify direct relationships among the factors and sources. Statistical cross tabulations are especially recommended for the "major" factors and "major" sources defined by this report. These "major" factors and sources are those which occur in the most stream miles. Of special interest are the factors associated with point and nonpoint sources of pollution, especially those related to agricultural practices. These additional analyses would provide a basis for examining potential management options for both fish communities and water quality.

COMPARISON OF FACTORS AND CAUSES WITH A STREAM'S ABILITY TO SUPPORT FISH

The determination of associations among factors and causes could be compared with the stream rankings in terms of their ability to support fish communities. While this report draws some general inferences about the past, present, and predicted future status of the Nation's fisheries, it was unable to demonstrate specific adverse factors affecting the Nation's waters and sources associated with these estimates. With the ability to derive fairly good estimates of factors adversely affecting the Nation's waters and the sources of these factors, fish management programs, such as stocking, could be analyzed in terms of the percentage of rank 2 through rank 5 streams that are threatened with agricultural nonpoint sources of pollution and are also maintained by stocking. Other analyses, similar to this example, should also be conducted.

COMPARISON OF RESULTS WITH DESIGNATED USE CLASSIFICATIONS

The results of the comparison of factors, causes, and the ability of a stream to support fish populations could also be compared with designated stream uses set by individual States. These designated uses, such as drinking water supply, industrial water supply, and fishery protection, are the uses set by the State's water quality standards. The results of this analysis could provide more insight into how well the Nation's water quality goals (i.e., fishable, swimmable) are being met. Reach conditions 5 years in the future, with and without control of man-caused factors, could be analyzed to further determine trends in the Nation's waters with respect to the attainment of designated use. The analysis would provide an estimate of whether the goals are attainable. The results would provide Federal, State, and local water quality management decisionmakers and planners with better information on the efficacy of existing regulations and the need for revisions.

GEOGRAPHICAL AND REGIONAL DIFFERENCES

Data on the geographical and regional differences in limiting factors, causes, and the past, present, and future status of the Nation's waters could be analyzed to provide additional clarification of problems and potential management strategies within known geographical boundaries. Boundaries could include ecoregion, major river basins, or other appropriate geographical divisions.

These analyses would provide needed data for consideration in planning priorities and allocation of resources. Specifically, these analyses could be used in the development of FWS Regional Resource Plans. Consistent use of the Survey sample design in each region, with expansion of the number of reaches sampled, could provide one of the first integrated assessments of regionally significant problems facing the Nation's water quality and fisheries resources. An expansion of the number of reaches sampled would be required because the existing sample data contain too few sampling points to have much ability to discover even important, large differences.

COMPARISON OF RESULTS WITH OTHER NATIONAL SURVEYS

The results of the Survey could be compared to the results of other National surveys such as the FWS National Survey of Fishing, Hunting, and Wildlife - Associated Recreation (U.S. Fish and Wildlife Service and U.S. Bureau of the Census 1982). Comparisons could include the public demand for quality fishing versus the ability to supply the demand. Economic evaluations relating potential losses in revenue to a wide variety of economic sectors as a result of not meeting the demand for quality fishing could also be conducted. Cost-benefit analyses of controlling significant factors adversely affecting stream fishery resources in areas of high public demand for quality fishing, e.g., urban areas, could also be investigated. These types of analyses would probably require an expansion of the existing Survey data base to take into account regional differences.

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Appendix A. Survey instrument.

OMB No. 2000-0410
Approval Expires 10/31/83

NATIONAL FISHERIES SURVEY

U.S. Fish and Wildlife Service
Ft. Collins, Colorado

U.S. Environmental Protection Agency
Washington, D.C.

Engineering-Science, Inc.

If you have any questions or need additional information concerning this questionnaire, please call the National Fisheries Survey toll-free number 1-800-525-2041. In Colorado, call 1-455-4427.

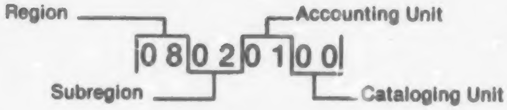
The reach described above was selected by a statistical sampling procedure. This reach is highlighted on the map on the following page for your reference when answering the questions.

OFFICE USE ONLY

FR__________	FWSR__________
FEd__________	KP__________
DR__________	2ED__________
DEd__________	DEd__________

Appendix A. (Continued.)

Hydrologic Unit Code



LEGEND

● County seat
○ City, town, or village
✈ Scheduled service airport

INTRODUCTION

This questionnaire is part of a combined U.S. Fish and Wildlife Service (FWS) and U.S. Environmental Protection Agency (EPA) effort to understand better the biological conditions of the nation's waters and to initiate the first nationwide fisheries data base. You have been selected to participate in the study because of your knowledge and expertise in the field of fisheries biology especially for the reach identified in this questionnaire.

The reach highlighted on the map was randomly selected from a national list of reaches contained in the EPA River Reach File. This file will also serve as the framework for the FWS fisheries data base.

The questions asked of you in this questionnaire were developed jointly by the FWS and the EPA, and were finalized based upon a pretest of the questionnaire conducted in the Fall of 1981. The principal focus of the questionnaire is on sport fish; this is not because sport fish are the only contributors to the value of the reach, but because the majority of available fisheries information concerns these species, and their presence or absence generally indicates conditions of prevailing water quality.

Because only a small number of reaches has been selected for this study, the participation of each scientist selected is extremely important. Please answer all questions. The information that you provide will be used only for statistical analysis of fisheries at the national level. You and your agency will receive copies of the final report of this National Fisheries Survey.

Appendix A. (Continued.)

For question 1, please print in the left hand column the scientific names of all species that occur in the reach at any time. Use additional names (e.g., *salmo gairdneri*—steelhead) if necessary to identify exactly the species present. Check or code all columns of the matrix that are applicable to these species. You may base your answer on personal experience through field sampling, discussion with colleagues or professional judgment.

For the purpose of answering this question, the following definitions apply:

- Sport fish: any fish with a legal limit (numbers, weight, or volume) set by your state's fishing regulations.
- Special concern: any fish species that is of particular concern to the state for preservation and management; included are state-listed threatened or endangered species, native species receiving special management attention, and other species of special concern for study and management; excluded are species receiving special management strictly to improve or diversify recreational fishing.
- Federal threatened or endangered species should be so indicated in the columns provided.

1.

POPULATION CODES

A—Presence
A = Abundant
C = Common
U = Uncommon
R = Rare
E = Expected
X = Unknown

B—Percentage of Reach with Species
1, 10, 20, etc.

C—Lifestage stocked
(If not stocked, leave blank)
E = Egg
L = Larvae
F = Fingerling
S = Subcatchable
C = Catchable

D—Frequency of stocking
1 = Less than once annually
2 = Annually
3 = More than once annually

	Check all that apply to the species.													Refer to population codes in box at left.			
	Fish Classes							Reach Description or Use						Population A	B	C	D
List the genus/species/subspecies, race, etc., for all fish species.	Sport	Anadromous	Endangered (Federal)	Threatened (Federal)	Special concern (State)	Commercial	Nonsport	Year round resident	Spawn elsewhere	Spawn and hatch	Nursery	Migration route	Over winter	Presence	Percentage of reach with species	Lifestage stocked	Frequency of stocking
1.																	
2.																	
3.																	
4.																	
5.																	
6.																	
7.																	
8.																	
9.																	
10.																	
11.																	

If you need more lines to complete the species list, use the back of the last page.

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Appendix A. (Continued.)

Question 2 is concerned with the type of information you have available to complete this questionnaire. For the purpose of completing these questions, the following definitions apply:

- Qualitative sampling: this includes visual reconnaissance surveys and techniques which indicate only a species' presence or absence.
- Quantitative sampling: this includes techniques which produce numerical data in the form of population and productivity estimates, relative abundance ratings, biomass estimates, nest or redd counts, etc.

2. Has fish sampling occurred within this reach? CIRCLE ONE NUMBER

Yes, definitely . . . . 1 ┐
Yes, suspected . . . . 2 ┘ → ANSWER A
Doubtful . . . . 3 ┐
No, definitely . . . . 4 ├ → ANSWER B
Unknown . . . . 5 ┘

IF SAMPLING OCCURRED (YES, DEFINITELY OR SUSPECTED)

A. List the year(s) of sampling for each type of survey within this reach.

Qualitative ______________________________

Quantitative ______________________________

IF REACH WAS NOT SAMPLED (NO, DEFINITELY OR DOUBTFUL)

B. Has fish sampling occurred within the cataloging unit? CIRCLE ONE NUMBER

Yes, definitely . . . . 1 ┐
Yes, suspected . . . . 2 ┘ → ANSWER C
Doubtful . . . . 3 ┐
No, definitely . . . . 4 ├ → GO TO Q. 3
Unknown . . . . 5 ┘

IF SAMPLING OCCURRED (YES, DEFINITELY OR SUSPECTED)

C. List the year(s) of sampling for each type of survey within this cataloging unit.

Qualitative ______________________________

Quantitative ______________________________

3. Check the months the reach has water usable as fish habitat during a normal water year.

All year	J	F	M	A	M	J	J	A	S	O	N	D	None
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Appendix A. (Continued.)

Question 4 concerns adverse conditions that may be affecting fish in the reach. Note that natural conditions are included in the tables. The tables should be completed one at a time. For example, if a reach is dammed and several adverse conditions result, each table (water quality, water quantity, usable habitat, fish community) should be completed as a unit. If the dam is causing gas supersaturation in the reach, #6 and #46 should be checked; if the dam blocks fish access to spawning gravel upstream, #27 and #71 should be checked. Check "other" only when necessary to explain reach conditions; keep explanations brief.

4. Is the survival, productivity, or use of the fish community being adversely affected by natural or man-made conditions in the reach? CIRCLE ONE NUMBER

Yes, definitely........... 1 ┐
Yes, suspected........... 2 ┘→ ANSWER A
Doubtful................ 3 ┐
No, definitely............ 4 ├→ GO TO Q. 5
Unknown................ 5 ┘

IF YES (DEFINITELY OR SUSPECTED):

A. Please complete the following tables by checking appropriate factors and sources. If possible, indicate if the factors and sources are of major or minor concern.

TABLE I.

WATER QUALITY

Check all applicable categories and circle 1 (Major) or 2 (Minor) in each category checked.

A. LIMITING FACTOR

	Major	Minor
1___Temperature too high	1	2
2___Temperature too low	1	2
3___Turbidity	1	2
4___Salinity	1	2
5___Dissolved oxygen	1	2
6___Gas supersaturation	1	2
7___pH too acidic	1	2
8___pH too basic	1	2
9___Nutrient deficiency	1	2
10___Nutrient surplus	1	2
11___Toxic substances	1	2
12___Other (specify below)		
______________________	1	2

B. PROBABLE SOURCE

	Major	Minor
39___Primarily upstream	1	2
40___Within reach	1	2
41___Point source discharge	1	2
42___Industrial	1	2
43___Municipal	1	2
44___Combined sewer	1	2
45___Mining	1	2
46___Dam release	1	2
47___Nonpoint source discharge	1	2
48___Individual sewage disposal	1	2
49___Urban runoff	1	2
50___Landfill leachate	1	2
51___Construction	1	2
52___Agriculture	1	2
53___Feedlot	1	2
54___Silviculture/logging	1	2
55___Mining	1	2
56___Natural	1	2
57___Unknown	1	2
58___Other (specify below)		
______________________	1	2

Appendix A. (Continued.)

TABLE II.

WATER QUANTITY

Check all applicable categories and circle 1 (Major) or 2 (Minor) in each category checked.

C. LIMITING FACTOR

	Major	Minor
13___Below optimum flows	1	2
14___Above optimum flows	1	2
15___Loss of flushing flows	1	2
16___Excessive flow fluctuation	1	2
17___Occasional low flow	1	2
18___Other (specify below)		
______________________	1	2

D. PROBABLE SOURCE

	Major	Minor
59___Dam (power)	1	2
60___Dam (flood control)	1	2
61___Dam (storage)	1	2
62___Diversion (agriculture)	1	2
63___Diversion (municipal)	1	2
64___Diversion (industrial)	1	2
65___Natural	1	2
66___Other (specify below)		
______________________	1	2

TABLE III.

USABLE HABITAT

Check all applicable categories and circle 1 (Major) or 2 (Minor) in each category checked.

E. LIMITING FACTOR

	Major	Minor
19___Adult/juvenile habitat	1	2
20___Pools	1	2
21___Riffles	1	2
22___Undercut banks	1	2
23___Boulders	1	2
24___Snags	1	2
25___Overhead cover	1	2
26___Egg/larvae habitat	1	2
27___Gravel	1	2
28___Plants, plant debris	1	2
29___Other (specify below)		
______________________	1	2

F. PROBABLE CAUSE

	Major	Minor
67___Excessive siltation	1	2
68___Bank erosion/sloughing	1	2
69___Channelization	1	2
70___Other channel modifications	1	2
71___Migration blockage	1	2
72___Natural	1	2
73___Unknown	1	2
74___Other (specify below)		
______________________	1	2

TABLE IV.

FISH COMMUNITY

Check all applicable categories and circle 1 (Major) or 2 (Minor) in each category checked.

G. LIMITING FACTOR

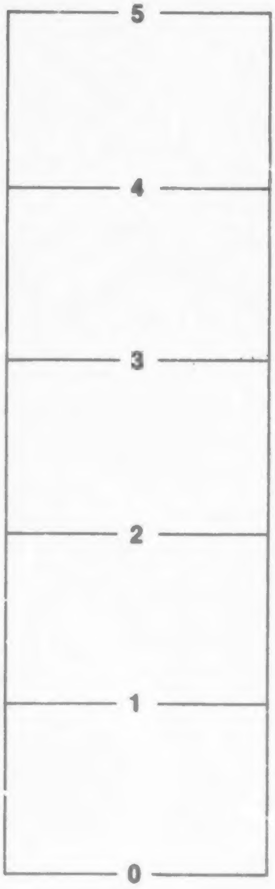
	Major	Minor
30___Fish kills	1	2
31___Contamination	1	2
32___Diseases/parasites	1	2
33___Tumors/lesions	1	2
34___Overharvest	1	2
35___Poaching	1	2
36___Underharvest	1	2
37___Fish stocking	1	2
38___Other (specify below)		
______________________	1	2

H. PROBABLE SOURCE

	Major	Minor
75___Heavy metals	1	2
76___Pesticides	1	2
77___Other noxious/toxic substances	1	2
78___Crowding	1	2
79___Other stress	1	2
80___Natural	1	2
81___Unknown	1	2
82___Other (specify below)		
______________________	1	2

Appendix A. (Continued.)

The next few questions are a subjective but necessary part of this survey. To provide some standardization for response, a "ladder" is shown below describing the spectrum of conditions that could exist in an aquatic ecosystem in terms of the fish community. At the top of the ladder is the ideal situation of maximum ability to support a fish community of high interest, i.e., a community of sport fish or other species of special concern. The bottom of the ladder represents a reach that is incapable of supporting any fish community. Please use this ladder as a reference in answering questions 5, 6, 7, 8, and 9.



The reach exhibits a maximum ability to support a community of sport fish, species of special concern, or both.

The reach exhibits a minimum ability to support a community of sport fish, species of special concern, or both.

The reach exhibits an ability to support a nonsport fish population only.

The reach has no ability to support any fish population.

Appendix A. (Continued.)

CHECK ONE BOX FOR EACH QUESTION

5. Using the scale shown on the opposite page, how would you rank the current conditions of the reach?

   ☐ ☐ ☐ ☐ ☐ ☐
   0 1 2 3 4 5

6. Again using this scale, how would you rank the conditions of the reach five years ago?

   ☐ ☐ ☐ ☐ ☐ ☐
   0 1 2 3 4 5

7. If present trends in the reach continue, how will it rank five years from now?

   ☐ ☐ ☐ ☐ ☐ ☐
   0 1 2 3 4 5

8. Should the man-caused limiting factors (if previously indicated in question 4A) be eliminated or controlled, how will the reach rank five years from now?

   ☐ ☐ ☐ ☐ ☐ ☐
   0 1 2 3 4 5

9. Considering, as a standard, a reach in the same or adjacent cataloging unit with the greatest ability to support sport fish, how would you rate that reach on the scale?

   ☐ ☐ ☐ ☐ ☐ ☐
   0 1 2 3 4 5

Appendix A. (Continued.)

USE THIS PAGE ONLY IF YOU NEED TO LIST MORE THAN 11 SPECIES OF FISH IN QUESTION 1.

POPULATION CODES

A—Presence
A = Abundant
C = Common
U = Uncommon
R = Rare
E = Expected
X = Unknown

B—Percentage of Reach with Species
1, 10, 20, etc.

C—Lifestage stocked
(If not stocked, leave blank)
E = Egg
L = Larvae
F = Fingerling
S = Subcatchable
C = Catchable

D—Frequency of stocking
1 = Less than once annually
2 = Annually
3 = More than once annually

	Check all that apply to the species.													**Refer to population codes in box at left.**			
	Fish Classes							**Reach Description or Use**						**Population**			
														A	**B**	**C**	**D**
List the genus/species/subspecies, race, etc., for all fish species.	Sport	Anadromous	Endangered (Federal)	Threatened (Federal)	Special concern (State)	Commercial	Nonsport	Year round resident	Spawn elsewhere	Spawn and hatch	Nursery	Migration route	Over winter	Presence	Percentage of reach with species	Lifestage stocked	Frequency of stocking
12.																	
13.																	
14.																	
15.																	
16.																	

Appendix A. (Concluded.)

RESPONDENT IDENTIFICATION

(to be filled out by the person who completed the questionnaire)*

Name ______________________________

State and Agency ______________________________

Department/Division ______________________________

Title ______________________________

Years in this position ______________________________

Years in the field of fisheries ______________________________

Years familiar with this river basin ______________________________

Present mailing address:

Room/Building No. ____________________ P.O. Box ____________________

Street ______________________________

City and State ______________________________

Zip Code ____________________ Telephone No. ____________________

*Please list the names of any additional people who assisted in completing the questionnaire.

____

____

____

____

____

Please return this questionnaire in the enclosed, self addressed, stamped envelope to:

APPENDIX B. NATIONAL FISHERIES SURVEY STATE KEY CONTACTS

Mr. Barry W. Smith, Asst. Chief
Alabama Dept. Conservation/
Natural Resources
Fisheries Section
64 North Union St.
Montgomery, Alabama 36130

Mr. Larry Rider
Arkansas State Game & Fish Comm.
Rt. 1, Box 286
Hartman, Arkansas 72840

Mr. G. E. Delisle
California Dept. Fish & Game
Room 1365
1416 Ninth St.
Sacramento, California 95814

Mr. Dave Weber
Colorado Division of Wildlife
Ecological Services Section
6060 Broadway
Denver, Colorado 80216

Mr. Forrest J. Ware, Chief
Bureau Fisheries Research
Florida Game & Freshwater
Fish Commission
620 South meridian St.
Tallahassee, Florida 32301

Mr. Richard M. Gennings, Chief
Georgia Dept. Natural Resources
270 Washington St., S.W.
Atlanta, Georgia 30334

Mr. James Keating
Chief of Fisheries
Idaho Dept. Fish & Game
Box 25
Boise, Idaho 83707

Mr. Les Frankland
Illinois Division Fish &
Wildlife Resources
400 South Spring St.
Springfield, Illinois 62706

Mr. James Mayhew, Fisheries Supt.
Iowa Conservation Commission
Wallace State Office Bldg.
Des Moines, Iowa 50319

Mr. Ken Brunson
Stream Investigations &
  Development Biologist
Kansas Fish and Game Dept.
Box 54 A, Rural Route 2
Pratt, Kansas 67124

Mr. Wayne L. Davis
Environmental Section
Kentucky Dept. Fish &
  Wildlife Resources
1 Game Farm Rd.
Frankfort, Kentucky 40601

Mr. Bennie J. Foutenot, Jr., Chief
Fisheries Division
Louisiana Dept. Wildlife & Fisheries
P.O. Box 14526
Baton Rouge, Louisiana 70898

Mr. Howard King
Maryland Dept. Natural Resources
580 Taylor Ave., Bldg. C-42
Annapolis, Maryland 21401

Mr. Peter H. Oatis
Chief Aquatic Biologist
Massachusetts Division of
  Fisheries & Wildlife
Field Headquarters
Westboro, Massachusetts 01581

Mr. Drew Parkin
New England Rivers Center
157 Kingralla Ave.
Cambridge, Massachusetts 02138

Mr. Thomas R. Doyle
Environmental Protection Specialist
Michigan Dept. Natural Resources
Box 30028
Lansing, Michigan 48909

Mr. Jack Enblom
Fisheries Section
Minnesota Dept. Natural Resources
Centennial One Bldg.
St. Paul, Minnesota 55155

Appendix B. (Continued.)

Mr. Bennie Herring
Mississippi Bureau Fish &
  Wildlife
P.O. Box 451
Jackson, Mississippi 38209

Mr. Richard E. Wehnes
Aquatic Environment Coordinator
Missouri Fisheries Division
P.O. Box 180
Jefferson City, Missouri 65102

Mr. George Holton
Montana Dept. Fish & Game
1420 East 6th Ave.
Helena, Montana 59620

Mr. J. Larry Hutchinson
Fishery Resource Specialist
Nebraska Game & Parks Commission
2200 North 33rd St.
Lincoln, Nebraska 68503

Mr. Leroy McLelland
Nevada Fish and Game Dept.
P.O. Box 10678
Reno, Nevada 89520

Mr. William Ingham
New Hampshire Fish & Game Dept.
Box 2003
34 Bridge St.
Concord, New Hampshire 03301

Mr. Bruce Pyle
Chief, Inland Fishery Division
New Jersey Comm., Fish, Game &
  Wildlife
P.O. Box CN 400
Trenton, New Jersey 08625

Mr. Warren McNall
New Mexico Dept. Game & Fish
State Capitol Bldg.
Santa Fe, New Mexico 87503

Mr. Paul Neth
New York Division of Fish &
  Wildlife
50 Wolf Rd.
Albany, New York 12233

Appendix B. (Continued.)

Mr. Scott L. Van Horn
Division Inland Fisheries
512 N. Salisbury St.
Raleigh, North Carolina 27611

Mr. Fred Ryckman, Mimnologist
North Dakota Game & Fish Dept.
2121 Lovett Ave.
Bismarck, North Dakota 58505

Mr. John H. Marshall
Environmental Program Coordinator
Ohio Dept. Natural Resources
Fountain Square
Columbus, Ohio 43224

Mr. Greg Summers
Oklahoma Fishery Research
Laboratory
1416 Planck St.
Norman, Oklahoma 73069

Mr. Lou Fredd
Environmental Management Section
Oregon Dept. Fish & Wildlife
506 S.W. Mill St.
Portland, Oregon 97208

Mr. Rich Hoopes
Pennsylvania Fish Commission
Roginson Lane
Bellfont, Pennsylvania 16823

Mr. Dan Crochet
309 Terrace Dr.
Florence, South Carolina 29501

Mr. Robert L. Hanten
Fisheries Staff Specialist
South Dakota Dept. Game, Fish &
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Anderson Bldg.
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Mr. Donny Scott
Tennessee Water Resources
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Ellington Agricultural Center
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Nashville, Tennessee 37204

Appendix B. (Concluded.)

Mr. Ernest G. Simmons
Chief Inland Fisheries
Texas Parks and Wildlife Dept.
4200 Smith School Rd.
Austin, Texas 78744

Mr. Howard O. Stopely
Acting Director
Utah Dept. Natural Resources &
Engery
1596 W. North Temple
Salt Lake City, Utah 84116

Mr. Angelo Incerpi, Chief
Vermont Division of Fisheries
State Office Bldg.
Montpelier, Vermont 05602

Mr. William E. Neal
Virginia Fish Management
Field Coordinator
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Mr. Jim De Shazo, Chief
Washington Department of Game
3939 Cleveland Ave.
Tumwater, Washington 98504

Mr. Sam Wright
Habitat Management Division
Washington Dept. of Fisheries
115 General Admin. Bldg.
Olympia, Washington 98504

Mr. John Klingdiel
Wisconsin Dept. Natural Resources
Bureau Fish Management
Box 7921
Madison, Wisconsin 53707

Mr. John Baughman
Fisheries Management Coordinator
Wyoming Game & fish Dept.
Cheyenne, Wyoming 82002

APPENDIX C. NATIONAL FISHERIES SURVEY LISTING OF FISH SPECIES

SCIENTIFIC NAME	COMMON NAME
ACANTHARCHUS POMOTIS	MUD SUNFISH
ACIPENSER FULVESCENS	LAKE STURGEON
ACIPENSER OXYRHYNCHUS	ATLANTIC STURGEON
ACROCHEILUS ALUTACEUS	CHISELMOUTH
ALOSA AESTIVALIS	BLUEBACK HERRING
ALOSA CHRYSOCHLORIS	SKIPJACK HERRING
ALOSA MEDIOCRIS	HICKORY SHAD
ALOSA PSEUDOHARENGUS	ALEWIFE
ALOSA SAPIDISSIMA	AMERICAN SHAD
AMBLOPLITES ARIOMMUS	SHADOW BASS
AMBLOPLITES CONSTELLATUS	OZARK BASS
AMBLOPLITES RUPESTRIS	ROCK BASS
AMIA CALVA	BOWFIN
AMMOCRYPTA ASPRELLA	CRYSTAL DARTER
AMMOCRYPTA BEANI	NAKED SAND DARTER
AMMOCRYPTA MERIDIANA	SOUTHERN SAND DARTER
AMMOCRYPTA VIVAX	SCALY SAND DARTER
AMPHISTICHUS RHODOTERUS	REDTAIL SURFPERCH
ANCHOA MITCHILLI	BAY ANCHOVY
ANGUILLA ROSTRATA	AMERICAN EEL
APHREDODERUS SAYANUS	PIRATE PERCH
APLODINOTUS GRUNNIENS	FRESHWATER DRUM
ARCHOSARGUS PROBATOCEPHALUS	SHEEPSHEAD
ARIUS FELIS	HARDHEAD CATFISH
BAGRE MARINUS	GAFFTOPSAIL CATFISH
BAIRDIELLA CHRYSOURA	SILVER PERCH
BREVOORTIA GUNTERI	FINESCALE MENHADEN
BREVOORTIA TYRANNUS	ATLANTIC MENHADEN
CAMPOSTOMA ANOMALUM	CENTRAL STONEROLLER
CAMPOSTOMA OLIGOLEPIS	LARGESCALE STONEROLLER
CARASSIUS AURATUS	GOLDFISH
CARPIODES CARPIO	RIVER CARPSUCKER
CARPIODES CYPRINUS	QUILLBACK
CARPIODES SP.	CARPSUCKERS
CARPIODES VELIFER	HIGHFIN CARPSUCKER
CATOSTOMUS CATOSTOMUS	LONGNOSE SUCKER
CATOSTOMUS COLUMBIANUS	BRIDGELIP SUCKER
CATOSTOMUS COMMERSONI	WHITE SUCKER
CATOSTOMUS DISCOBOLUS	BLUEHEAD SUCKER
CATOSTOMUS LATIPINNIS	FLANNELMOUTH SUCKER
CATOSTOMUS MACROCHEILUS	LARGESCALE SUCKER
CATOSTOMA MICROPS	MODOC SUCKER
CATOSTOMUS PLEBEIUS	RIO GRANDE SUCKER
CATOSTOMUS SP.	SUCKERS
CATOSTOMUS SYNCHEILUS	FINE-SCALED SUCKER
CATOSTOMUS TAHOENSIS	TAHOE SUCKER
CENTRARCHUS MACROPTERUS	FLIER
CENTROPOMUS SP.	SNOOK

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Appendix C. (Continued.)

CHOLOGASTER CORNUTA	SWAMPFISH
CLARIAS BATRACHUS	WALKING CATFISH
CLINOSTOMUS ELONGATUS	REDSIDE DACE
CLINOSTOMUS FUNDULOIDES	ROSYSIDE DACE
CLUPEA HARENGUS HARENGUS	ATLANTIC HERRING
COREGONUS CLUPEAFORMIS	LAKE WHITEFISH
COREGONUS SP.	CISCO
COTTUS ASPER	PRICKLY SCULPIN
COTTUS BAIRDI	MOTTLED SCULPIN
COTTUS CAROLINAE	BANDED SCULPIN
COTTUS COGNATUS	SLIMY SCULPIN
COTTUS CONFUSUS	SHORTHEAD SCULPIN
COTTUS GIRARDI	POTAMAC SCULPIN
COTTUS GULOSUS	RIFFLE SCULPIN
COTTUS RHOTHEUS	TORRENT SCULPIN
COTTUS SP.	SCULPINS
COUESIUS PLUMBEUS	LAKE CHUB
CTENOPHARYNGODON IDELLA	GRASS CARP
CULAEA INCONSTANS	BROOK STICKLEBACK
CYCLEPTUS ELONGATUS	BLUE SUCKER
CYPRINUS CARPIO	COMMON CARP
CYPRINODON RUBROFLUVIATILIS	RED RIVER PUPFISH
DORMITATOR MACULATUS	FAT SLEEPER
DOROSOMA CEPEDIANUM	GIZZARD SHAD
DOROSOMA PETENENSE	THREADFIN SHAD
DOROSOMA SP.	SHADS
ELASSOMA SP.	PYGMY SUNFISH
ELASSOMA ZONATUM	BANDED PYGMY SUNFISH
ELOPS SAURUS	LADYFISH
ENNEACANTHUS CHAETODUN	BLACKBANDED SUNFISH
ENNEACANTHUS GLORIOSUS	BLUESPOTTED SUNFISH
ENNEACANTHUS OBESUS	BANDED SUNFISH
ERICYMBA BUCCATA	SILVERJAW MINNOW
ERIMYZON OBLONGUS	CREEK CHUBSUCKER
ERIMYZON SP.	CHUBSUCKER
ERIMYZON SUCETTA	LAKE CHUBSUCKER
ERIMYZON TENUIS	SHARPFIN CHUBSUCKER
ESOX AMERICANUS AMERICANUS	PICKEREL
ESOX AMERICANUS VERMICULATUS	GRASS PICKEREL
ESOX LUCIUS	NORTHERN PIKE
ESOX MASQUINONG-LUCIUS(HY)	TIGER MUSKY (HYBRID)
ESOX MASQUINONGY	MUSKELLUNGE (MUSKY)
ESOX NIGER	CHAIN PICKEREL
ESOX SP.	PICKEREL
ETHEOSTOMA ASPRIGENE	MUD DARTER
ETHEOSTOMA BLENNIODES	GREENSIDE DARTER
ETHEOSTOMA CAERULEUM	RAINBOW DARTER
ETHEOSTOMA CHLOROBRANCHIUM	GREENFIN DARTER
ETHEOSTOMA CHLOROSOMUM	ASHY DARTER
ETHEOSTOMA COLLETTEI	CREOLE DARTER
ETHEOSTOMA EDWINI	CHERRY DARTER
ETHEOSTOMA FLABELLARE	FANTAIL DARTER

Appendix C. (Continued.)

ETHEOSTOMA FRICKSIUM	SAVANNAH DARTER
ETHEOSTOMA FUSIFORME	SWAMP DARTER
ETHEOSTOMA GRACILE	SLOUGH DARTER
ETHEOSTOMA HISTRIO	HARLEQUIN DARTER
ETHEOSTOMA INSCRIPTUM	TURQUOISE DARTER
ETHEOSTOMA JORDANI	GREENBREAST DARTER
ETHEOSTOMA NIGRUM	JOHNNY DARTER
ETHEOSTOMA OBEYENSE	BARCHEEK DARTER
ETHEOSTOMA OLMSTEDI	TESSELLATED DARTER
ETHEOSTOMA PALIDIDORSUM	PALEBACK DARTER
ETHEOSTOMA PARVIPINNE	GOLDSTRIPE DARTER
ETHEOSTOMA PROLIARE	CYPRESS DARTER
ETHEOSTOMA PUNCTULATUM	STIPPLED DARTER
ETHEOSTOMA RADIOSUM	ORANGEBELLY DARTER
ETHEOSTOMA RUFILINEATUM	REDLINE DARTER
ETHEOSTOMA RUPESTRE	ROCK DARTER
ETHEOSTOMA SERRIFERUM	SAWCHEEK DARTER
ETHEOSTOMA SP.	DARTERS
ETHEOSTOMA SPECTABILE	ORANGETHROAT DARTER
ETHEOSTOMA STIGMAEUM	SPECKLED DARTER
ETHEOSTOMA SWAINI	GULF DARTER
ETHEOSTOMA ULOCENTRA	*UNDESCRIBED*
ETHEOSTOMA VARIATUM	VARIEGATED DARTER
ETHEOSTOMA VIRGATUM	STRIPED DARTER
ETHEOSTOMA VITREUM	GLASSY DARTER
ETHEOSTOMA WHIPPLEI	REDFIN DARTER
ETHEOSTOMA ZONALE	BANDED DARTER
EXOGLOSSUM MAXILLINGUA	CUTLIPS MINNOW
FUNDULUS CATENATUS	NORTHERN STUDFISH
FUNDULUS CHRYSOTUS	GOLDEN TOPMINNOW
FUNDULUS DIAPHANUS	BANDED KILLIFISH
FUNDULUS LINEOLATUS	LINED TOPMINNOW
FUNDULUS NOTATUS	BLACKSTRIPE TOPMINNOW
FUNDULUS NOTTI	STARHEAD TOPMINNOW
FUNDULUS OLIVACEUS	BLACKSPOTTED TOPMINNOW
FUNDULUS SP.	TOPMINNOW
FUNDULUS ZEBRINUS	PLAINS KILLIFISH
GAMBUSIA AFFINIS	MOSQUITOFISH
GASTEROSTEUS ACULEATUS	THREESPINE STICKLEBACK
GILA BICOLOR	TUI CHUB
GILA COPEI	LEATHERSIDE CHUB
GILA ROBUSTA	ROUNDTAILED CHUB
GOBIOMORUS DORMITOR	BIGMOUTH SLEEPER
HESPEROLEUCUS PARVIPINNIS	HYBRID
HIODON ALOSOIDES	GOLDEYE
HIODON TERGISUS	MOONEYE
HYBOPSIS AESTIVALIS	SPECKLED CHUB
HYBOPSIS AMBLOPS	BIGEYE CHUB
HYBOGNATHUS ARGYRITIS	WESTERN SILVERY MINNOW
HYBOPSIS DISSIMILIS	STREAMLINE CHUB
HYBOPSIS GELIDA	STURGEON CHUB
HYBOPSIS GRACILIS	FLATHEAD CHUB

Appendix C. (Continued.)

HYBOGNATHUS HANKINSONI	BRASSY MINNOW
HYBOGNATHUS HAYI	CYPRESS MINNOW
HYBONATHUS HAYI	CYPRESS MINNOW
HYBOPSIS HYPSINOTUS	HIGHBACK CHUB
HYBOPSIS LABROSA	THICKLIP CHUB
HYBOGNATHUS NUCHALIS	MISSISSIPPI SILVERY CHUB
HYBOGNATHUS REGIUS	EASTERN SILVERY MINNOW
HYBOPSIS RUBRIFRONS	ROSYFACE CHUB
HYBOGNATHUS SP.	MINNOWS
HYBOPSIS SP.	CHUB
HYBOPSIS STORERIANA	SILVER CHUB
HYPENTELIUM ETOWANUM	ALABAMA HOG SUCKER
HYPENTELIUM NIGRICANS	NORTHERN HOG SUCKER
HYPOMESUS TRANSPACIFICUS	DELTA SMELT
ICHTHYOMYZON CASTANEUS	CHESTNUT LAMPREY
ICHTHYOMYZON GAGEI	SOUTHERN BROOK LAMPREY
ICHTHYOMYZON UNICUSPIS	SILVER LAMPREY
ICTALURUS CATUS	WHITE CATFISH
ICTALURUS FURCATUS	BLUE CATFISH
ICTALURUS MELAS	BLACK BULLHEAD
ICTALURUS NATALIS	YELLOW BULLHEAD
ICTALURUS NEBULOSUS	BROWN BULLHEAD
ICTALURUS PLATYCEPHALUS	FLAT BULLHEAD
ICTALURUS PUNCTATUS	CHANNEL CATFISH
ICTALURUS SERRACANTHUS	SPOTTED BULLHEAD
ICTALURUS SP.	CATFISH
ICTIOBUS BUBALUS	SMALLMOUTH BUFFALO
ICTIOBUS CYPRINELLUS	BIGMOUTH BUFFALO
ICTIOBUS NIGER	BLACK BUFFALO
ICTIOBUS SP.	BUFFALOS
LABIDESTHES SICCULUS	BROOK SILVERSIDE
LAMPETRA AEPYPTERA	LEAST BROOK LAMPREY
LAMPETRA APPENDIX	AMERICAN BROOK LAMPREY
LEIOSTOMUS XANTHURUS	SPOT
LEPISOSTEUS OCULATUS	SPOTTED GAR
LEPISOSTEUS OSSEUS	LONGNOSE GAR
LEPISOSTEUS PLATOSTOMUS	SHORTNOSE GAR
LEPISOSTEUS PLATYRHINCUS	FLORIDA GAR
LEPISTOSTEUS SPATULA	ALLIGATOR GAR
LEPOMIS AURITUS	REDBREAST SUNFISH
LEPOMIS CYANELLUS	GREEN SUNFISH
LEPOMIS GIBBOSUS	PUMPKINSEED
LEPOMIS GULOSUS	WARMOUTH
LEPOMIS HUMILUS	ORANGESPOTTED SUNFISH
LEPOMIS MACROCHIRUS	BLUEGILL
LEPOMIS MARGINATUS	DOLLAR SUNFISH
LEPOMIS MEGALOTIS	LONGEAR SUNFISH
LEPOMIS MICROLOPHUS	REDEAR SUNFISH
LEPOMIS PUNCTATUS	SPOTTED SUNFISH
LEPOMIS SP.	SUNFISH
LEPOMIS SYMMETRICUS	BANTAM SUNFISH
LOTA LOTA	BURBOT

Appendix C. (Continued.)

LUCANIA PARVA	RAINWATER KILLIFISH
LUTJANUS GRISEUS	GRAY SNAPPER
MEGALOPS ATLANTICUS	TARPON
MENIDIA AUDENS	MISSISSIPPI SIVERSIDE
MENIDIA BERYLLINA	INLAND SILVERSIDE
MICROPTERUS COOSAE	REDEYE BASS
MICROPTERUS DOLOMIEUI	SMALLMOUTH BASS
MICROPTERUS PUNCTULATUS	SPOTTED BASS
MICROPTERUS SALMOINDES	LARGE MOUTH BASS
MICROPOGON UNDULATUS	ATLANTIC CROAKER
MINYTREMA MELANOPS	SPOTTED SUCKER
MORONE AMERICANA	WHITE PERCH
MORONE CHRYSOPS	WHITE BASS
MORONE MISSISSIPPIENSIS	YELLOW BASS
MORONE SAXATILUS	STRIPED BASS
MOXOSTOMA ANISURUM	SILVER REDHORSE
MOXOSTOMA CARINATUM	RIVER REDHORSE
MOXOSTOMA CONGESTUM	GRAY REDHORSE
MOXOSTOMA DUQUESNEI	BLACK REDHORSE
MOXOSTOMA ERYTHRURUM	GOLDEN REDHORSE
MOXOTOMA LACHNERI	GREATER JUMPROCK
MOXOSTOMA MACROLEPIDOTUM	SHORTHEAD REDHORSE
MOXOSTOMA POECILURUM	BLACKTAIL REDHORSE
MOXOTOMA ROBUSTUM	SMALLFIN REDHORSE
MOXOSTOMA RUPISCARTES	STRIPED JUMPROCK
MOXOSTOMA SP.	SUCKERS
MOXOSTOMA VALENCIENNESI	GREATER REDHORSE
MUGIL CEPHALUS	STRIPED MULLET
MYLOCHEILUS CAURINUS	PEAMOUTH
MYLOPHARODON CONOCEPHALUS	HARDHEAD
NOCOMIS BIGUTTATUS	HORNYHEAD CHUB
NOCOMIS LEPTOCEPHALUS	BLUE HEAD CHUB
NOCOMIS MICROPOGON	RIVER CHUB
NOTEMIGONUS CRYSOLEUCAS	GOLDEN SHINER
NOTROPIS ALBORUS	WHITEMOUTH SHINER
NOTROPIS ALTIPINNIS	HIGHFIN SHINER
NOTROPIS AMNIS	PALLID SHINER
NOTROPIS AMOENUS	COMELY SHINER
NOTROPIS ANALOSTANUS	SATINFIN SHINER
NOTROPIS ARDENS	ROSEFIN SHINER
NOTROPIS ARIOMMUS	POPEYE SHINER
NOTROPIS ASPERIFRONS	BURRHEAD SHINER
NOTROPIS ATHERINOIDES	EMERALD SHINER
NOTROPIS ATROCAUDALIS	BLACKSPOT SHINER
NOTROPIS BAILEYI	ROUGH SHINER
NOTROPIS BAIRDI	RED RIVER SHINER
NOTROPIS BELLUS	PRETTY SHINER
NOTROPIS BIFRENATUS	BRIDLE SHINER
NOTROPIS BLENNIUS	RIVER SHINER
NOTROPIS BOOPS	BIGEYE SHINER
NOTROPIS BUCHANANI	GHOST SHINER
NOTROPIS CALLISEMA	OCMULGEE SHINER

Appendix C. (Continued.)

NOTROPIS CALLISTIUS	ALABAMA SHINER
NOTROPIS CALLITAENIA	BLUESTRIPE SHINER
NOTROPIS CAMURUS	BLUNTFACE SHINER
NOTROPIS CHALYBAEUS	IRONCOLOR SHINER
NOTROPIS CHILITICUS	REDLIP SHINER
NOTROPIS CHLORISTIUS	GREENFIN SHINER
NOTROPIS CHROSOMUS	RAINBOW SHINER
NOTROPIS CHRYSOCEPHALUS	STRIPED SHINER
NOTROPIS CORNUTUS	COMMON SHINER
NOTROPIS CUMMINGSAE	DUSKY SHINER
NOTROPIS DORSALIS	BIGMOUTH SHINER
NOTROPIS EMILAE	PUGNOSE MINNOW
NOTROPIS FUMEUS	RIBBON SHINER
NOTROPIS GALACTURUS	WHITETAIL SHINER
NOTROPIS HARPERI	REDEYE CHUB
NOTROPIS HETERODON	BLACKCHIN SHINER
NOTROPIS HETEROLOPIS	BLACKNOSE SHINER
NOTROPIS HUDSONIUS	SPOTTAIL SHINER
NOTROPIS HYPSELOPTERUS	SAILFIN SHINER
NOTROPIS LEUCIODUS	TENNESSEE SHINER
NOTROPIS LIRUS	MOUNTAIN SHINER
NOTROPIS LONGIROSTRIS	LONGNOSE SHINER
NOTROPIS LUTIPINNIS	YELLOWFIN SHINER
NOTROPIS LUTRENSIS	RED SHINER
NOTROPIS MACULATUS	TAILLIGHT SHINER
NOTROPIS NIVEUS	WHITEFIN SHINER
NOTROPIS NUBILUS	OZARK MINNOW
NOTROPIS OXYRHYNCHUS	SHARPNOSE SHINER
NOTROPIS PETERSONI	COASTAL SHINER
NOTROPIS PHOTOGENIS	SILVER SHINER
NOTROPIS PILSBRYI	DUSKYSTRIPE SHINER
NOTROPIS POTTERI	CHUB SHINER
NOTROPIS PROCNE	SWALLOWTAIL SHINER
NOTROPIS PYRRHOMELAS	FIERYBLACK SHINER
NOTROPIS ROSEIPINNIS	CHERRYFIN SHINNER
NOTROPIS RUBELLUS	ROSYFACE SHINER
NOTROPIS SABINAE	SABINE SHINER
NOTROPIS SCEPTICUS	SANDBAR SHINER
NOTROPIS SHIPPLEI	STEELCOLOR SHINER
NOTROPIS SHUMARDI	SILVERBAND SHINER
NOTROPIS SIGNIPINNIS	FLAGFIN SHINER
NOTROPIS SIMUS	BLUNTNOSE SHINER
NOTROPIS SP.	SHINERS
NOTROPIS SPILOPTERUS	SPOTFIN SHINER
NOTROPIS STILBIUS	SILVERSTRIPE SHINER
NOTROPIS STRAMINEUS	SAND SHINER
NOTROPIS TELESCOPUS	TELESCOPE SHINER
NOTROPIS TEXANUS	WEED SHINER
NOTROPIS TRICHROISTIUS	TRICOLOR SHINER
NOTROPIS UMBRATILIS	REDFIN SHINER
NOTROPIS VENUSTUS	BLACKTAIL SHINER
NOTROPIS VOLUCELLUS	MIMIC SHINER

NOTROPIS WHIPPLEI	STEELCOLOR SHINER
NOTROPIS XAENOCEPHALUS	COOSA SHINER
NOTROPIS XAENURUS	ALTAMAHA SHINER
NOTROPIS ZONATUS	BLEEDING SHINER
NOTROPIS ZONISTIUS	BANDFIN SHINER
NOTURUS ALBATER	OZARK MADTOM
NOTURUS EXILIS	SLENDER MADTOM
NOTURUS FLAVUS	STONECAT
NOTURUS FUNEBRIS	BLACK MADTOM
NOTURUS GYRINUS	TADPOLE MADTOM
NOTURUS INSIGNIS	MARGINED MADTOM
NOTURUS LEPTACANTHUS	SPECKLED MADTOM
NOTURUS MIURUS	BRINDLED MADTOM
NOTURUS NOCTURNUS	FRECKLED MADTOM
NOTURUS PHAEUS	BROWN MADTOM
NOTURUS SP.	MADTOMS
OSMERUS MORDAX	RAINBOW SMELT
PARALICHTHYS LETHOSTIGMA	SOUTHERN FLOUNDER
PERCINA CAPRODES	LOGPERCH
PERCINA COPELANDI	CHANNEL DARTER
PERCINA CRASSA	PIEDMONT DARTER
PERCINA EVIDES	GILT DARTER
PERCA FLAVESCENS	YELLOW PERCH
PERCINA LINTICULA	FRECKLED DARTER
PERCINA MACROCEPHALA	LONGHEAD DARTER
PERCINA MACULATA	BLACKSIDE DARTER
PERCINA NIGROFASCIATA	BLACKBANDED DARTER
PERCOPSIS OMISCOMAYCUS	TROUT PERCH
PERCINA OUACHITAE	SADDLEBACK DARTER
PERCINA PELTATA	SHIELD DARTER
PERCINA PHOXOCEPHALA	SLENDERHEAD DARTER
PERCINA SCIERA	DUSKY DARTER
PERCINA SHUMARDI	RIVER DARTER
PERCINA SQUAMATA	OLIVE DARTER
PERCOPSIS TRANSMONTANA	SAND ROLLER
PERCINA URANIDAE	STARGAZING DARTER
PETROMYZON MARINUS	SEA LAMPREY
PHENACOBIUS CATOSTOMUS	RIFFLE MINNOW
PHENACOBIUS MIRABILIS	SUCKERMOUTH MINNOW
PHOXINUS EOS	NORTHERN REDBELLY DACE
PHOXINUS ERYTHROGASTER	SOUTHERN REDBELLY DACE
PIMEPHALES NOTATUS	BLUNTNOSE MINNOW
PIMEPHALES PROMELAS	FATHEAD MINNOW
PIMEPHALES SP.	MINNOWS
PIMEPHALES VIGILAX	BULLHEAD MINNOW
POECILIA MEXICANA	SHORTFIN MOLLY
POGONIAS CROMIS	BLACKDRUM
POLYODON SPATHULA	PADDLEFISH
POMATOMUS SALTATRIX	BLUEFISH
POMOXIS ANNULARIS	WHITE CRAPPIE
POMOXIS NIGROMACULATUS	BLACK CRAPPIE
POMOXIS SP.	CRAPPIE

Appendix C. (Concluded.)

PROSOPIUM COULTERI	PYGMY WHITEFISH
PYLODICTUS OLIVARIS	FLATHEAD CATFISH
RHINICHTHYS ATRATULUS	BLACKNOSE DACE
RHINICHTHYS CATARACTAE	LONGNOSE DACE
RHINICHTHYS FALCATUS	LEOPARD DACE
RHINICHTHYS OSCULUS	SPECKLED DACE
RHINICHTHYS SP.	DACE
RICHARDSONIUS BALTEATUS	REDSIDE SHINER
RICHARDSONIUS EGREGIUS	LAHONTON REDSIDE
SALMO GAIRDNERI	RAINBOW (NOT ANADROMOUS)
SALMO SALAR	ATLANTIC SALMON
SALMO SALAR	ATLANTIC SALMON (LAND LOCKED)
SALMO TRUTTA	BROWN TROUT
SALVELINUS CONFLUENTUS	BULL TROUT
SCAPHIRHYNCHUS ALBUS	PALLID STURGEON
SCAPHIRHYNCHUS PLATORYNCHUS	SHOVELNOSE STURGEON
SCIAENOPS OCELLATUS	RED DRUM (CHANNEL BASS)
SEMOTILUS ATROMACULATUS	CREEK CHUB
SEMOTILUS CORPORALIS	FALLFISH
SEMOTILUS MARGARITA	PEARL DACE
SPIRINCHUS THALEICHTHYS	LONGFIN SMELT
STIZOSTEDION CANADENSE	SAUGER
STIZOSTEDION VITREUM VITREUM	WALLEYE
STRONGYLURA MARINA	ATLANTIC NEEDLEFISH
THALEICHTHYS PACIFICUS	EULACHON
TINCA TINCA	TENCH
TRINECTES MACULATUS	HOGCHOKER
UMBRA LIMI	CENTRAL MUDMINNOW
UMBRA PYGMAEA	EASTERN MUDDMINNOW
XIPHOPHORUS VARIATUS	VARIABLE PLATYFISH
XYRAUCHEN TEXANUS	RAZORBACK SUCKER

Table D-1a. Ten most prevalent sports fish species in the Nation's waters (all streams).

Common Name	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Confidence Interval Biased	Percent
Largemouth bass	263859	20951	221957	305761		27.31
Rainbow trout steelhead	213461	24645	164171	262751		22.09
Bluegill	188495	21232	146031	230959		19.51
Channel catfish	148343	18647	111049	185637		15.35
Smallmouth bass	142142	16821	108500	175784		14.71
Green sunfish	126074	17616	90842	161306		13.05
Brook trout	103507	14811	73885	133129		10.71
Black crappie	98190	14777	68636	127744		10.16
Spotted bass	98129	16317	65495	130763		10.16
Rockbass	94682	16318	62046	127318		9.80

Table D-1b. Ten most prevalent nonsport fish species in the Nation's waters (all streams).

Common Name	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Confidence Interval Biased	Percent
Common carp	187417	18303	150811	224023		19.4
Creek chub	176709	18221	140267	213151		18.29
White sucker	166823	19354	128115	205531		17.27
Gizzard shad	131730	17422	96886	166574		13.63
Bluntnose minnow	126665	20228	86209	167121		13.11
Stoneroller	122337	17370	87597	157077		12.66
Green sunfish	115234	19274	76686	153782		11.93
Common shiner	112112	16671	78770	145454		11.6
Fathead minnow	110531	16685	77161	143901		11.44
Golden shiner	106602	15996	74610	138594		11.03

Table D-2a. Distribution of fish types by class (all streams).

Fish Class	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Sport	701780	29806	642168	761392	502956	770104	72.64
Anadromous	102145	18485	65175	139115	53428	299640	10.57
Commercial	163005	19396	124213	201797	98406	342762	16.87
Nonsport	657606	26869	603868	711344	473696	731984	68.07
Anadromous	20198	8250	3698	36698	3266	225384	2.09
Endangered/threatened	7720	4420	0	16560	0	215147	.8
Special concern	23204	6317	10570	35838	8571	228147	2.4
None	204074	20069	163936	244212	132139	378967	21.12

Table D-2b. Extent of fish classes (perennial streams).

Fish Classes	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Sport	636260	28987	578286	694234	454028	657915	65.86
Anadromous	100216	18291	63634	136798	52215	233746	10.37
Commercial	153377	18394	116589	190165	92394	270179	15.88
Nonsport	582895	25987	530921	634869	417425	612967	60.33
Anadromous	19540	8070	3400	35680	3045	158635	2.02
Endangered/threatened	7720	4420	0	16560	0	148959	.8
Special concern	21450	5963	9524	33376	7663	160449	2.22
None	18298	4968	8362	28234	6552	155964	1.89

Table D-3a. Reach use by sport and nonsport fish (all streams).

Reach Use	Length (Miles)	Standard Error	Confidence interval Unbiased (95%)		Confidence interval Biased		Percent
Year round sport fish	633635	29986	573663	693607	450504	718020	65.59
Sport fish spawning elsewhere	96413	15023	66367	126459	51930	286690	9.98
Sport fish spawning and hatching	657376	29958	597460	717292	469003	736341	68.04
Sport fish nursery	653968	29802	594364	713572	466836	734046	67.69
Sport fish migration	115184	18441	78302	152066	63102	308570	11.92
Sport fish overwintering	640921	29630	581661	700181	456141	722441	66.34
Nonsport fish year round	600946	27526	545894	655998	428772	690862	62.31
Nonsport fish spawing elsewhere	65553	12011	631531	679575	33463	266548	6.8
Nonsport fish spawing and hatching	616794	27550	561694	1850382	441197	703211	63.95
Nonsport fish nursery	611247	27444	556359	666135	437400	699079	63.37
Nonsport fish migration	37956	9420	19116	56796	15852	244457	3.94
Nonsport fish overwintering	602539	27423	547693	657385	430074	691849	62.47

Table D-4a. Abundance of the Nation's fish species (all streams).

Fish Abundance	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Sport fish species abundant	221694	25039	171616	271772	123107	446706	22.98
Sport fish species common	391757	25335	341087	442427	244028	558691	40.61
Sport fish species uncommon	52582	8075	36432	68732	25035	310396	5.45
Sport fish species rare	12228	4749	2730	21726	1898	283978	1.27
Sport fish species expected	65619	11078	43463	87775	30734	321628	6.8
Nonsport fish species abundant	334700	25956	282788	386612	194188	548841	35.13
Nonsport fish species common	303713	26001	251711	355715	173055	525676	31.88
Nonsport fish species uncommon	22344	5473	11398	33290	8333	327934	2.34
Nonsport fish species rare	4727	2487	0	9701	0	316013	.5
Nonsport fish species expected	60414	11466	37482	83346	26881	356813	6.34

Table D-4b. Abundance of fish species (perennial streams).

Fish Abundance	Length (Miles)	Standard Error	Confidence Interval				
			Unbiased (95%)		Biased		Percent
Sport fish species abundant	208263	24026	160211	256315	114856	353136	21.59
Sport fish species common	354024	24136	305752	402296	220034	448200	36.72
Sport fish species uncommon	45118	7396	30326	59910	20751	218555	4.68
Sport fish species rare	10196	4292	1612	18780	1047	194879	1.06
Sport fish species expected	59984	10730	38524	81444	27404	232121	6.22
Nonsport fish species abundant	306363	24082	258199	354527	177501	452653	32.16
Nonsport fish species uncommon	13874	4202	5470	22278	3916	242991	1.46
Nonsport fish species rare	3758	2290	0	8338	0	236227	.39
Nonsport fish species expected	53286	10006	33274	73298	23944	273470	5.59

Table D-5a. Proportion of each given reach supporting fish species (all streams).

	Sport Fish 0			Sport Fish 1-24		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.3668	0.0269	0.2135 - 0.6188	0.0	0.0	0.0 - 0.3624
Nonsport fish 1-24	0.0	0.0	0.0 - 0.3624	0.0085	0.0035	0.0010 - 0.3680
Nonsport fish 25-49	0.0	0.0	0.0 - 0.3624	0.0041	0.0029	0.0 - 0.3644
Nonsport fish 50-74	0.0	0.0	0.0 - 0.3624	0.0059	0.0036	0.0 - 0.3656
Nonsport fish 75-100	0.0021	0.0021	0.0 - 0.3637	0.0147	0.0042	0.0039 - 0.3713
Sport Fish total	0.3536	0.0258	0.2301 - 0.5535	0.0334	0.0070	0.0136 - 0.2953

Table D-5a. (continued).

	Sport Fish 25-49			Sport Fish 50-74		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.0	0.0	0.0 - 0.3624	0.0	0.0	0.0 - 0.3624
Nonsport fish 1-24	0.0	0.0	0.0 - 0.3624	0.0	0.0	0.0 - 0.3624
Nonsport fish 25-49	0.0050	0.0030	0.0 - 0.3658	0.0060	0.0027	0.0004 - 0.3662
Nonsport fish 50-74	0.0117	0.0042	0.0019 - 0.3693	0.0376	0.0080	0.0147 - 0.3884
Nonsport fish 75-100	0.0235	0.0057	0.0076 - 0.3774	0.0561	0.0088	0.0254 - 0.3993
Sport Fish total	0.0381	0.0071	0.0172 - 0.3003	0.0994	0.0121	0.0566 - 0.3493

Table D-5a. (concluded).

	Sport Fish 75-100			Nonsport fish total		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.0019	0.0014	0.0 - 0.3637	0.3601	0.0263	0.2279 - 0.5870
Nonsport fish 1-24	0.0922	0.0016	0.0 - 0.3637	0.0159	0.0045	0.3252 - 0.0051
Nonsport fish 25-49	0.0025	0.0018	0.0 - 0.3638	0.0185	0.0054	0.0052 - 0.3259
Nonsport fish 50-74	0.0171	0.0071	0.0018 - 0.3750	0.0757	0.0130	0.0348 - 0.3689
Nonsport fish 75-100	0.4342	0.0242	0.2577 - 0.6565	0.5298	0.0245	0.3392 - 0.6933
Sport Fish total	0.4755	0.0253	0.3233 - 0.6432	—	—	—

Table D-5b. Proportion of each given reach supporting fish species (perennial streams).

	Sport Fish 0			Sport Fish 1-24		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.1240	0.0176	0.0604 - 0.3555	0.0	0.0	0.0 - 0.2657
Nonsport fish 1-24	0.0	0.0	0.0 - 0.2657	0.0039	0.0023	0.0 - 0.2682
Nonsport fish 25-49	0.0	0.0	0.0 - 0.2657	0.0018	0.0018	0.0 - 0.2668
Nonsport fish 50-74	0.0	0.0	0.0 - 0.2657	0.0059	0.0036	0.0 - 0.2689
Nonsport fish 75-100	0.0021	0.0021	0.0 - 0.2670	0.0123	0.0037	0.0031 - 0.2732
Sport Fish total	0.1327	0.0184	0.0717 - 0.2929	0.0209	0.0055	0.0071 - 0.1978

Table D-5b. (continued).

	Sport Fish 25-49			Sport Fish 50-74		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.0	0.0	0.0 - 0.2657	0.0	0.0	0.0 - 0.2657
Nonsport fish 1-24	0.0	0.0	0.0 - 0.2657	0.0	0.0	0.0 - 0.2657
Nonsport fish 25-49	0.0037	0.0027	0.0 - 0.2682	0.0048	0.0024	0.0 - 0.2688
Nonsport fish 50-74	0.0106	0.0039	0.0016 - 0.2720	0.0317	0.0075	0.0109 - 0.2668
Nonsport fish 75-100	0.0222	0.0056	0.0070 - 0.2799	0.0469	0.0084	0.0203 - 0.2967
Sport Fish total	0.0352	0.0068	0.0155 - 0.2095	0.0846	0.0117	0.0460 - 0.2494

Table D-5b. (concluded).

	Sport Fish 75-100			Nonsport fish Total		
	Proportion	Standard Error	Confidence Interval	Proportion	Standard Error	Confidence Interval
Nonsport fish 0	0.0019	0.0014	0.0 - 0.2671	0.1254	0.0172	0.0680 - 0.3336
Nonsport fish 1-24	0.0022	0.0016	0.0 - 0.2670	0.0087	0.0031	0.0019 - 0.2406
Nonsport fish 25-49	0.0010	0.0010	0.0 - 0.2665	0.0102	0.0039	0.0016 - 0.2418
Nonsport fish 50-74	0.0171	0.0071	0.0018 - 0.2785	0.0661	0.0125	0.0287 - 0.2826
Nonsport fish 75-100	0.4117	0.0238	0.2430 - 0.5487	0.4888	0.0242	0.3113 - 0.5886
Sport Fish total	0.4486	0.0250	0.3038 - 0.5425	—	—	—

Table D-6a. Extent and frequency of stocking sport fish in the Nation's waters (all streams).

Sport Fish Community	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Stocked with eggs	0	*	0	0	0	207490	0
Stocked with larvae	786	786	0	2358	0	207968	.08
Stocked fingerlings	78596	11937	54722	102470	42985	271611	8.13
Stocked with subcatchables	15424	4403	6618	24230	5313	220303	1.6
Stocked with catchables	65186	10562	44062	86310	34787	260985	6.75
More than one stage stocked	19520	5705	8110	30930	5791	223537	2.02
Stocked less than once annually	64906	9529	45848	83964	35707	258937	6.72
Stocked annually	71798	10747	52740	93292	39757	265957	7.43
Stocked more than once annually	30040	6804	16432	43648	12981	232135	3.11

Table D-6b. Estimated extent and frequency of stocking of sport fish (perennial streams).

Sport Fish Community Is:	Length	Standard	Confidence Interval				
	(Miles)	Error	Unbiased (95%)		Biased		Percent
Stocked with eggs	0	0	0	0	0	141083	0
Stocked with larvae	786	786	0	2358	0	141551	.08
Stocked with fingerlings	73978	11154	51670	96286	40574	201905	7.66
Stocked with subcatchables	15424	4403	6618	24230	5313	153927	1.6
Stocked with catchables	64235	10545	43145	85325	34066	194694	6.65
More than one stage stocked	19520	5706	8108	30932	5791	157123	2.02
Stocked less than once annually	63342	9484	44374	82310	34487	191695	6.56
Stocked annually	68014	9875	48264	87764	38149	196993	7.04
Stocked more than once annually	29089	6748	15593	42585	12322	165261	3.01

Table D-7a. Reaches where the fish community is being adversely affected (all streams).

Adverse Effects	Length (Miles)	Standard Error	Confidence Interval				
			Unbiased (95%)		Biased		Percent
Water quality	535084	29283	476518	593650	396335	630115	56.02
Water quantity	649102	30670	587762	710442	498055	730391	67.95
Usable habitat	464885	28219	408447	521323	335707	566387	48.67
Fish community	309630	25352	258926	360334	211050	434836	32.41
Total adversely affected	773330	29328	714674	831986	600912	831167	81.01
No adverse effects	180327	17700	144927	215727	118020	323473	18.89

Table D-7b. Reaches where the survival, productivity or use of the fish community are adversely affected (perennial streams).

Adverse Effects	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Water quality	433987	27496	378995	488979	310991	513283	45.43
Water quantity	387874	27074	333726	442022	276158	476200	40.6
Usable habitat	387024	25870	335284	438764	273754	471316	40.52
Fish community	261018	23059	214900	363059	173288	363059	27.32
Total adversely affected	508332	28329	451674	564990	371050	577303	53.25
No adverse effects	157831	17206	123419	192243	100558	275287	16.53

Table D-8a. Water quality factors adversely affecting fish (all streams).

Limiting Factor	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Temperature too high	250187	23371	203445	296929	170151	392638	26.21
Temperature too low	29877	12721	4435	55319	3670	200455	3.13
Turbidity	328261	28662	270937	385585	223253	456696	34.39
Salinity	17217	4337	8543	25891	6891	184976	1.8
Dissolved oxygen	91022	15491	60040	122004	49512	249198	9.53
Gas supersaturation	5500	2505	490	10510	273	174680	.58
pH - Too acidic	24793	8080	8633	40953	7035	191730	2.6
pH - too basic	3998	1767	464	7532	430	174137	.42
Nutrient deficiency	40603	13368	13867	67339	11896	209131	4.25
Nutrient surplus	119519	16166	87187	151851	70826	272246	12.52
Toxic substances	93602	15429	62744	124460	50332	250796	9.81
Other	26685	6304	14077	39293	11739	193850	2.79
Channelization	2937	1453	31	173278	41	173278	.31
Herbicides and pesticides	4356	4356	0	13068	0	173510	.46
Intermittent	4839	2403	33	9645	0	175045	.51
Low flows	24364	6783	10798	37930	9042	193599	2.55
Sedimentation	14378	7660	0	29598	0	182772	1.51
Siltation	9644	5749	0	21142	0	178409	1.01

Table D-8b. Adverse conditions affecting fish - water quality parameters (perennial streams).

Limiting Factor	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Temperature too high	187251	19361	148529	225973	122719	304441	19.1
Temperature too low	27710	12480	2750	52670	2261	168244	2.9
Turbidity	276943	26537	223869	330017	181988	381144	29.01
Salinity	14571	3992	6587	22555	5254	152255	1.53
Dissolved oxygen	75368	13362	48644	102092	39675	205366	7.9
Gas supersaturation	5500	2505	490	10510	273	143994	.58
pH - Too acidic	23502	7974	7554	39450	6063	160000	2.46
pH - too basic	2475	1430	0	5335	0	142019	.26
Nutrient deficiency	37126	13129	10868	63384	9299	176154	3.89
Nutrient surplus	107434	14768	77898	136970	62579	231590	11.25
Toxic substances	86549	13958	58633	114465	46963	214754	9.07
Other	23211	5651	11909	34513	9880	160031	2.43
Channelization	1701	1209	0	4119	0	141461	.18
Herbicides and pesticides	4356	4356	0	13068	0	142812	.46
Intermittent	0	0	0	0	0	139835	0
Low flows	7079	2536	2007	12151	1699	143914	.74
Sedimentation	14378	7660	0	29698	0	152286	1.51
Siltation	7889	4202	0	16293	0	146445	.83

Table D-9a. Adverse conditions affecting fish - water quality parameters (all streams).

Limiting Factor	Factor a Major Concern Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased		Factor a Minor Concern Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased	
Temperature too high	.1367	.0175	.1017	.1717	.0875	.3103	.1241	.0161	.0919	.1563	.0772	.2896
Temperature too low	.0175	.0095	0	.0365	0	.1987	.0138	.0047	.0044	.0232	.0037	.1942
Turbidity	.1692	.0181	.133	.2054	.1119	.331	.1734	.0206	.1322	.2146	.1089	.334
Salinity	.0045	.0023	0	.0091	0	.1864	.0135	.0039	.0057	.0213	.0047	.1941
Dissolved oxygen	.0516	.0117	.0282	.075	.0233	.2291	.0438	.0124	.019	.0686	.0172	.2209
Gas supersaturation	.001	.001	0	.003	0	.1833	.0028	.002	0	.0068	0	.1847
pH - too acidic	.0146	.0076	0	.0298	0	.1943	.0096	.0035	.0026	.0166	.002	.1908
ph - too basic	.0026	.0015	0	.0056	0	.1848	.0016	.0011	0	.0038	0	.1841
Nutrient deficiency	.019	.0098	0	.0386	0	.1989	.0228	.0055	.0118	.0338	.0104	.2026
Nutrient surplus	.0586	.0138	.031	.0862	.0261	.2336	.0666	.0101	.0464	.0868	.0386	.2402
Toxic substances	.0358	.0107	.0144	.0572	.011	.2129	.0623	.0099	0	.0821	.0352	.2362
Other	.0215	.0056	.0103	.0327	.0088	.2014	.0057	.0026	.0006	.0109	.0005	.1875
Channelization	.0023	.0014	0	.0051	0	.1846	0	0	0	0	0	.1825
Herbicides and pesticides	.0046	.0046	0	.0138	0	.1867	0	0	0	0	0	.1825
Intermittent	.0051	.0025	.0001	.0101	0	.1874	0	0	0	0	0	.1825
Low flows	.0244	.007	.0104	.0384	.0089	.2064	.0012	.0012	0	.0036	0	.1834
Sedimentation	.0132	.0074	0	.028	0	.1935	.0019	.0013	0	.0045	0	.1842
Siltation	.0073	.0056	0	.0185	0	.188	.0028	.0021	0	.007	0	.1853

Table D-9b. Adverse conditions affecting fish - water quality parameters (perennial streams).

	Factor a Major Concern						Factor a Minor Concern					
Limiting Factor	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Temperature too high	.0896	.014	.0616	.1176	.0519	.2331	.1061	.0144	.0773	.1349	.0647	.2414
Temperature too low	.016	.0094	0	.0348	0	.1632	.013	.0047	.0036	.0224	.0031	.1609
Turbidity	.1338	.0166	.1006	.167	.0825	.2663	.1557	.0194	.1169	.1945	.0962	.2869
Salinity	.0017	.0012	0	.0041	0	.1513	.0135	.0039	.0057	.0213	.0047	.1616
Dissolved oxygen	.0416	.0102	.0212	.062	.0174	.1875	.0373	.0106	.0161	.0585	.0146	.1829
Gas supersaturation	.001	.001	0	.003	0	.1505	.0028	.002	0	.0068	0	.152
pH - too acidic	.0146	.0076	0	.0298	0	.1619	.0083	.0032	.0019	.0147	.0015	.1568
pH - too basic	.0026	.0015	0	.0056	0	.1521	0	0	0	0	0	.1498
Nutrient deficiency	.0178	.0096	0	.037	0	.1659	.0204	.0054	.0096	.0312	.0083	.1678
Nutrient surplus	.0552	.0123	.0306	.0798	.0255	.1983	.0573	.0094	.0385	.0761	.0316	.1993
Toxic substances	.0318	.0096	.0126	.051	.009	.1774	.0588	.09	0	.2388	.0338	.2007
Other	.0195	.005	.0095	.0295	.0082	.1668	.0048	.0021	.0006	.009	.0005	.1541
Channelization	.001	.001	0	.003	0	.1307	0	0	0	0	0	.1498
Herbicides and pesticides	.0046	.0046	0	.0138	0	.133	0	0	0	0	0	.1498
Intermittent	0	0	0	0	0	.1498	0	0	0	0	0	.1498
Low flows	.0063	.0024	.0015	.0111	.0013	.1555	.0012	.0012	0	.0036	0	.1506
Sedimentation	.0132	.0074	0	.028	0	.161	.0019	.0013	0	.0045	0	.1515
Siltation	.0055	.0039	0	.0133	0	.1539	.0028	.0021	0	.007	0	.1527

Table D-10a. Probable sources of water quality factors adversely affecting fish (all streams).

Probable Sources	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Primary upstream	162859	17288	128283	197435	104749	311475	17.05
Within reacj	257029	23702	209625	304433	170675	392346	26.92
Point source discharge	117684	14266	89152	146216	72110	273183	12.33
Industrial	47097	8491	30115	64079	23905	213469	4.93
Municipal	63816	9602	44612	83020	35841	227791	6.69
Combined sewer	29246	6304	16638	41854	13860	200082	3.06
Mining	28686	10749	7188	50184	6045	201287	3.01
Dam release	19314	4191	10932	27696	8665	189724	2.02
Nonpoint source discharge	367244	26747	313750	420738	2555109	484567	38.43
Individual sewage disposal	47823	15053	17717	77929	14432	216484	5.01
Urban runoff	40376	8260	23856	56896	19100	210482	4.23
Landfill leachate	5504	2213	1078	9930	800	178452	.58
Construction	29110	8335	12440	45780	10166	200362	3.05
Agriculture	281241	22143	236955	325527	191044	407492	29.46
Feedlot	59947	11959	36029	83865	29473	225055	6.28
Silvic./logging	71736	13811	44114	99358	37821	240722	7.51
Mining	31847	9579	12689	51005	10600	203102	3.34
Natural	212389	22053	168283	256495	144207	366967	22.24
Other	19445	4289	10867	28023	8724	190799	2.04
Bedload movement	5299	2811	0	10921	0	179148	.56
Grazing	21970	8212	5546	38394	4194	196216	2.3
Roads	3569	2214	0	7997	0	177493	.37

Table D-10b. Sources of adverse conditions affecting fish - water quality parameters (perennial streams).

Probable Source	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Primarily upstream	146954	15847	115260	178648	93890	266420	15.39
Within reach	226659	21706	183247	270071	148874	335939	23.74
Point source discharge	116572	14234	88104	145040	71230	241282	12.21
Industrial	47097	8491	30115	64079	23905	181896	4.93
Municipal	62703	9544	43615	81791	35008	195473	6.57
Combined sewer	29246	6304	16638	41854	13860	168379	3.06
Mining	28686	10749	7188	50184	6045	169566	3.01
Dam release	19314	4191	10932	27696	8665	157577	2.02
Nonpoint source discharge	330840	25705	279430	425243	226344	425243	34.62
Individual sewage disposal	46069	13889	18291	73847	14625	183152	4.83
Urban runoff	38027	8104	21819	54235	17321	175764	3.98
Landfill leachate	5504	2213	1078	9930	800	146317	.58
Construction	29110	8335	12440	45780	10166	168603	3.05
Agriculture	250637	20559	209519	291755	168064	352585	26.25
Feedlot	53775	10768	32239	75311	26165	187970	5.63
Silvic/logging	68981	13475	42031	95931	36097	206743	7.22
Mining	30894	9550	11794	49994	9885	170580	3.24
Natural	149893	19605	110683	189103	92740	277115	15.69
Other	18524	4216	10092	26956	6102	158097	1.94
Bedload movement	5299	2811	0	10921	0	147059	.56
Grazing	19515	8092	3331	35699	2402	162749	2.04
Roads	3569	2214	0	7997	0	145083	.37

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Table D-11a. Sources of adverse conditions affecting fish - water quality parameters (all streams).

Probable Source	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Primarily upstream	.1149	.0133	.0883	.1415	.0721	.2814	.0532	.0101	.033	.0734	.0273	.2326
Within reach	.17	.0198	.1304	.2096	.1068	.3307	.0938	.0123	.0692	.1184	.0568	.264
Point source discharge	.0498	.0083	.0332	.0664	.0271	.2265	.0561	.0094	.0373	.0749	.0305	.2323
Industrial	.0186	.0055	.0076	.0296	.0061	.2017	.0307	.007	.0167	.0447	.0135	.2133
Municipal	.0303	.0067	.0169	.0437	.014	.2126	.0366	.0072	.0222	.051	.0181	.2174
Combined sewer	.0173	.0047	.0079	.0267	.0068	.202	.0133	.004	.0053	.0213	.0045	.1983
Mining	.0215	.009	.0035	.0395	.0029	.2062	.0086	.004	.0006	.0166	.0005	.1941
Dam release	.01	.0031	.0038	.0162	.0033	.1943	.0102	.0032	.0038	.0166	.003	.1943
Nonpoint source discharge	.1891	.0212	.1467	.2315	.1108	.334	.1507	.016	.1187	.1827	.0956	.312
Individual sewage disposal	.0103	.0048	.0007	.0199	.0005	.1956	.0398	.0129	.014	.0656	.0119	.2197
Urban runoff	.0057	.0025	.0007	.0107	.0007	.1918	.0366	.0082	.0202	.053	.0168	.2197
Landfill leachate	.0008	.0008	0	.0024	0	.1873	.005	.0022	.0006	.0094	.0004	.1902
Construction	.0151	.0057	.0037	.0265	.0033	.2004	.0154	.0053	.0048	.026	.0038	.1990
Agriculture	.1731	.0199	.1345	.2117	.1064	.3288	.1208	.0139	.093	.1486	.0793	.2941
Feedlot	.0235	.0088	.0059	.0411	.0051	.2058	.0394	.0093	0	.068	.0174	.2222
Silvic./logging	.0333	.0101	.0131	.0535	.0113	.2172	.0417	.0086	.0247	.0587	.0218	.2239
Mining	.0193	.009	.0013	.0373	.0013	.205	.0141	.0044	.0053	.0229	.0044	.1987
Natural	.1421	.0171	.1079	.1763	.095	.3171	.0793	.0116	.0561	.1025	.0474	.2557
Other	.0146	.004	.0066	.0226	.0055	.1993	.0046	.002	.002	.0086	0	.1985
Bedload movement	.0009	.0009	0	.0027	0	.1873	.0047	.0028	0	.0103	0	.1989
Grazing	.0187	.0078	.0031	.0343	.0023	.2058	.0043	.0022	0	.0087	0	.1982
Roads	.0037	.0023	0	.0083	0	.1899	0	0	0	0	0	.1866

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Table D-11b. Sources of adverse conditions affecting fish - water quality parameters (perennial streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Primarily upstream	.1035	.0126	.0783	.1287	.0637	.2379	.488	.0087	.4706	.5054	.026	.1948
Within reach	.146	.018	.11	.182	.0901	.2775	.0858	.0111	.0636	.108	.052	.2227
Point source discharge	.0498	.0083	.0332	.0664	.0271	.1929	.0549	.0093	.0363	.0735	.0295	.1977
Industrial	.0186	.0055	.0076	.0296	.0061	.1676	.0307	.007	.0167	.0447	.0135	.1795
Municipal	.0303	.0067	.0169	.0437	.014	.1788	.0354	.0071	.0212	.0496	.0172	.1826
Combined sewer	.0173	.0047	.0079	.0267	.0068	.168	.0133	.004	.0053	.0213	.004	.1643
Mining	.0215	.009	.0035	.0395	.0029	.1723	.0086	.004	.0006	.0166	.0005	.1599
Dam release	.01	.0031	.0038	.0162	.0033	.16	.0102	.0032	.0038	.0166	.003	.1602
Nonpoint source discharge	.171	.0201	.1308	.2112	.0988	.2883	.1372	.0153	.1066	.1678	.0851	.2674
Individual sewage disposal	.0103	.0048	.0007	.0199	.0005	.1614	.0379	.0114	.0151	.0607	.0126	.184
Urban runoff	.0057	.0025	.0007	.0107	.0007	.1577	.0342	.008	.0182	.0502	.0148	.1827
Landfill leachate	.0008	.0008	0	.0024	0	.153	.005	.0022	.0006	.0094	.0004	.156
Construction	.0151	.0057	.0037	.0265	.0033	.1644	.0154	.0053	.0048	.026	.0028	.1657
Agriculture	.1526	.0179	.1168	.1884	.0921	.2799	.1092	.0131	.083	.1354	.0703	.251
Feedlot	.0224	.0081	.0062	.0386	.0053	.1706	.034	.082	0	.198	.0145	.1835
Silvic./logging	.0314	.0097	.012	.0508	.0102	.1816	.0406	.0085	.0236	.0576	.0211	.189
Mining	.0193	.009	.0013	.0373	.0013	.1712	.0131	.0043	.0045	.0217	.0037	.1635
Natural	.0875	.0147	.0581	.1169	.0496	.2309	.0685	.0107	.0471	.0899	.0396	.2122
Other	.0137	.0039	.0059	.0215	.0049	.1643	.0046	.002	.002	.0086	.0004	.1563
Bedload movement	.0009	.0009	0	.0027	0	.1531	.0047	.0028	0	.0103	0	.1567
Grazing	.0171	.0076	.0019	.0323	.0012	.1708	.0033	.002	0	.0073	0	.1552
Roads	.0037	.0023	0	.0083	0	.1554	0	0	0	0	0	.1523

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Table D-12a. Water quantity factors adversely affecting fish (all streams).

Limiting Factors	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Below optimum flows	300370	24653	251064	349676	215129	441746	31.47
Above optimum flows	29354	8129	13096	45612	10406	194493	3.08
Loss of flushing flows	13431	4342	4747	22115	4028	182316	1.41
Excessive flow fluctuation	158874	21627	115620	202128	96359	311494	16.64
Occasional low flow	214945	19817	176311	255579	147234	358367	22.62
Other	43465	8884	25697	61233	22037	209876	4.55
Dwatered	7462	4567	0	16596	0	177499	.78
Dry	49403	10888	27627	71179	25336	221319	5.18
Intermittent	92562	16065	60432	124692	50544	254619	9.7
Low flows	7384	2592	2200	12568	1853	176782	.77

Table D-12b. Adverse conditions affecting fish - water quantity parameters (perennial streams).

Limiting Factor	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Below optimum flows	187979	19053	149873	226085	126018	307547	19.69
Above optimum flows	27845	8106	11633	44057	9241	162950	2.92
Lows of flushing water	13431	4342	4747	22115	4028	151690	1.41
Excessive flow fluctuation	118402	19025	80352	156452	65212	244799	12.4
Occasional low flow	178676	17736	143204	214148	119202	296619	18.72
Other	12413	3209	5995	18831	4677	149740	1.3
Dewatered	4968	3188	0	11344	0	144400	.52
Dry	2788	1689	0	6166	0	142448	.29
Intermittent	17203	5607	5989	28417	5058	155693	1.80
Low flows	5944	2423	1098	10790	899	144858	.62

Table D-13a. Adverse conditions affecting fish-water quantity parameters (all streams).

	Factor a Major Concern						Factor a Minor Concern					
Limiting Factor	Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased		Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased	
Below optimum flows	.2275	.0223	.183	.2722	.1611	.3968	.0861	.0129	.0603	.1119	.0514	.2577
Above optimum flows	.0105	.0046	.0013	.0197	.0008	.1905	.0202	.0057	.0088	.0316	.0073	.199
Loss of flushing flows	.0059	.0036	0	.0131	0	.1883	.0082	.0029	.0024	.014	.002	.1894
Excessive flow fluctuation	.115	.0193	.0764	.1536	.0629	.284	.051	.0096	.0318	.0702	.0277	.2292
Occasional low flow	.0898	.0116	.0666	.113	.0567	.2622	.1352	.0155	.1042	.1662	.087	.3002
Other	.0189	.0068	.0073	.0305	.0057	.1984	.0019	.0013	0	.0045	0	.1838
Dewatered	.0051	.0033	0	.0117	0	.187	.0015	.0015	0	.0045	0	.1839
Dry	.0508	.0112	0	.0732	.0266	.2356	.001	.001	0	.003	0	.1836
Intermittent	.0963	.0165	.0633	.1293	.0536	.2713	.0007	.0007	0	.0021	0	.1832
Low flows	.0077	.0027	.0023	.0131	.002	.1892	0	0	0	0	0	.1825

Table D-13b. Adverse conditions affecting fish - water quantity parameters (perennial streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Below optimum flows	.1145	.0153	.0839	.1451	.0722	.3968	.0812	.0123	.0566	.1058	.0481	.2212
Above optimum flows	.0097	.0045	.0007	.0187	.0003	.1577	.0194	.0057	.008	.0308	.0067	.1659
Lows of flushing flows	.0059	.0036	0	.0131	0	.1555	.0082	.0029	.0024	.014	.002	.1568
Excessive flow fluctuation	.0801	.0166	.0469	.1133	.0369	.219	.0434	.0087	.026	.0608	.0226	.1899
Occasional low flow	.0605	.0088	.0429	.0781	.0367	.2033	.1254	.0149	.0956	.1552	.08	.2608
Other	.0103	.003	.0043	.0163	.0035	.1583	.0019	.0013	0	.0045	0	.1511
Dewatered	.0025	.0018	0	.0061	0	.1519	.0015	.0015	0	.0045	0	.1512
Dry	.002	.0015	0	.005	.0	.1515	.001	.001	0	.003	0	.1509
Intermittent	.018	.0059	.0062	.0298	.0054	.1667	0	0	0	0	0	.1498
Low flows	.0062	.0025	.0012	.0112	.001	.1552	0	0	0	0	0	.1498

Table D-14a. Probable sources of water quantity factors adversely affecting fish (all streams).

Probable Sources	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Dam (power)	24821	5598	13625	36017	10721	190540	2.6
Dam (flood control)	28002	5895	16212	39792	12820	193661	2.93
Dam (storage)	32901	5479	21943	43859	17547	198438	3.45
Diversion (agriculture)	130223	14290	101643	158803	85861	285934	13.64
Diversion (municipal)	10694	3696	3302	18086	2773	180343	1.12
Diversion (industrial)	3292	1938	0	7168	0	173562	.34
Natural	477791	28890	420011	535571	361068	594252	50.05
Other	18851	5476	7899	29803	6420	185601	1.97
Channelization	10629	4942	745	20513	733	178714	1.11
Floods/low flows	10527	10527	0	31581	0	179445	1.1
Logging	6271	4025	0	14321	0	176261	.66
Ditches	5335	2720	0	10775	0	175355	.56
Irrigation	8897	3197	2503	15291	2023	177611	.93

Table D-14b. Sources of adverse conditions affecting fish - water quantity (perennial streams).

Probable Source	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Confidence Interval Biased		Percent
Dam (power)	24821	5598	13625	36017	10721	159864	2.6
Dam (flood control)	26899	5855	15189	38609	11995	162318	2.82
Dam (storage)	30817	5371	20075	41559	16051	165048	3.23
Diversion (agriculture)	104659	12073	80513	128805	67832	233617	10.96
Diversion (municipal)	10694	3696	3302	18086	2773	149797	1.12
Diversion (industrial)	3292	1938	0	7168	0	142776	.34
Natural	245678	24076	197526	293830	165666	359559	25.74
Other	16279	4874	6531	26027	5201	152932	1.71
Channelization	10178	4921	336	20020	366	147725	1.07
Floods/low flows	8773	8773	0	26319	0	146990	.92
Logging	4408	3042	0	10492	0	143951	.46
Ditches	5335	2720	0	10775	0	144809	.56
Irrigation	6387	2408	1571	11203	1279	144911	.67

Table D-15a. Sources of adverse conditions affecting fish - water quantity (all streams).

	Factor a Major Concern						Factor a Minor Concern					
Probable Source	Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased		Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased	
Dam (power)	.0162	.0043	.0076	.0248	.006	.1956	.0098	.0037	.0024	.0172	.002	.1908
Dam (flood control)	.0189	.0051	.0087	.0291	.0068	.1982	.0104	.0032	.004	.0168	.0032	.1915
Dam (storage)	.0206	.0047	.0112	.03	.0092	.1996	.0138	.0035	.0068	.0208	.0056	.1943
Diversion (agriculture)	.0816	.0121	.0574	.1058	.0488	.2561	.0535	.0105	.0325	.0745	.0284	.2321
Diversion (municipal)	.0045	.0024	0	.0093	0	.1868	.0067	.0025	.0017	.0117	.0015	.1885
Diversion (industrial)	.0024	.0017	0	.0058	0	.1845	.0011	.0011	0	.0033	0	.1836
Natural	.3765	.0239	.3287	.4243	.2864	.5224	.1238	.0145	.0948	.1528	.0815	.2936
Other	.0145	.0052	.0041	.0249	.0035	.1945	.0043	0021	.0001	.0085	0	.1859
Channelization	.0092	.005	0	.0192	0	.1898	.0014	.0014	0	.0042	0	.1835
Floods/low flows	.011	.011	0	.033	0	.1917	0	0	0	0	0	.1825
Logging	.0066	.0042	0	.015	0	.1885	0	0	0	0	0	.1825
Ditch	.0056	.0029	0	.0114	0	.1877	0	0	0	0	0	.1825
Irrigation	.0073	.0031	.0011	.0135	.001	.1883	.0015	.001	0	.0035	0	.1838

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Table D-15b. Sources of adverse conditions affecting fish - water quantity (perennial streams).

	Factor a Major Concern						Factor a Minor Concern					
Limiting Factor	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Dam (power)	.0162	.0043	.0076	.0248	.006	.1628	.0098	.0037	.0024	.0172	.002	.1582
Dam (flood control)	.0178	.0052	.0074	.0282	.006	.1648	.0104	.0032	.004	.0168	.0032	.1587
Dam (storage)	.0184	.0045	.0094	.0274	.0077	.1651	.0138	.0035	.0068	.0208	.0056	.1615
Diversion (agriculture)	.0608	.0096	.0416	.08	.0354	.2052	.0474	.0094	.0286	.0662	.0249	.1942
Diversion (municipal)	.0045	.0024	0	.0093	0	.1541	.0067	.0025	.0017	.0117	.0015	.1539
Diversion (industrial)	.0024	.0017	0	.0058	0	.1518	.0011	.0011	0	.0033	0	.1506
Natural	.1522	.0192	.1138	.1906	.0959	.2872	.1053	.0136	.0781	.1325	.0667	.245
Other	.0118	.0045	.0028	.0208	.0023	.1597	.0043	.0021	.0001	.0085	0	.1532
Channelization	.0092	.0052	0	.0196	0	.1572	.0014	.0014	0	.0042	0	.1508
Floods/low flows	.0092	.0091	0	.0274	0	.1572	0	0	0	0	0	.1498
Logging	.0046	.0032	0	.011	0	.1542	0	0	0	0	0	.1498
Ditch	.0056	.0029	0	.0114	0	.1551	0	0	0	0	0	.1498
Irrigation	.0056	.0024	.0008	.0104	.0007	.1543	.0006	.0006	0	.0018	0	.1502

Table D-16a. Factors adversely affecting usable fish habitat (all streams).

Limiting Factors	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Adult/juvenile habitat	385394	27351	330692	440096	270754	500911	40.37
Pools	197533	21731	154071	240995	125196	337638	20.7
Riffles	29090	17590	93910	164270	74119	275952	13.52
Undercut banks	103692	15145	73402	133982	59322	258537	10.86
Boulders	51768	10640	30488	73048	24289	214177	5.42
Snags	61866	12871	36124	87608	27950	219006	6.48
Overhead cover	134232	17417	99398	169066	80042	283735	14.06
Egg/larvae habitat	269972	23205	223562	316382	182162	400201	28.28
Gravel	156540	17417	121706	191374	98393	303104	16.4
Plant, plant debris	62412	13517	35378	89446	28084	219203	6.54
Other	31374	6599	18176	44572	14434	197077	3.29
Intermittent	11498	5584	330	22666	84	182389	1.2
Low flows	3434	1600	234	6634	242	173265	.36

Table D-16b. Adverse conditions affecting fish - usable habitat parameters (perennial streams).

Limiting Factor	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Adult/ juvenile habitat	324954	24914	275126	374782	223899	419674	34.04
Pools	162276	19612	123052	201500	99462	278349	17
Riffles	110125	15737	78651	141599	61751	229838	11.54
Undercut banks	91158	14031	63096	119220	50966	217741	9.55
Boulders	46889	10143	26603	67175	21126	179665	4.91
Snags	51242	11268	28706	73778	21936	179891	5.37
Overhead cover	116608	15726	85156	148060	68170	238991	12.22
Egg/larvae habitat	243822	21624	200574	287070	163321	348833	25.54
Gravel	143049	16569	109911	176187	89080	262269	14.99
Plant, plant debris	54757	11469	31819	77695	25212	182688	5.74
Other	25317	5634	14049	36585	11152	161554	2.65
Intermittent	2807	1624	0	6055	0	142418	.29
Low flows	1310	895	0	3100	0	140953	.14

Table D-17a. Adverse conditions affecting fish - usable habitat parameters (all streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval Unbiased (95%)		Biased		Proportion	Standard Error	Confidence Interval Unbiased	(95%)	Biased	
Adult/juvenile habitat	.2266	.0204	.1858	.2674	.1496	.3732	.1629	.0155	.1319	.1939	.1078	.3212
Pools	.1128	.0174	.078	.1476	.0632	.2777	.0941	.012	.0701	.1181	.058	.264
Riffles	.0748	.0125	.0498	.0998	.0396	.243	.0606	.0101	.0403	.0807	.0321	.2322
Undercut banks	.0562	.0123	.0316	.0808	.0258	.2313	.0524	.009	.0344	.0704	.0283	.2269
Boulders	.0306	.0087	.0132	.048	.011	.2087	.0236	.0061	.0114	.0358	.0092	.2021
Snags	.0315	.0076	.0163	.0163	.0131	.207	.0333	.0109	.0115	.0551	.0089	.2093
Overhead cover	.0759	.0146	.0467	.1051	.0372	.2458	.0648	.0102	.0444	.0852	.0375	.2396
Egg/larvae habitat	.1553	.0169	.1215	.1891	.0991	.3146	.1131	.0176	.0779	.1483	.0638	.2799
Gravel	.0958	.0132	.0694	.1222	.068	.2661	.0681	.0103	.0475	.0887	.0383	.239
Plants, plant debris	.0286	.0072	.0142	.043	.0116	.2047	.0368	.0121	.0126	.061	.0107	.2121
Other	.0193	.005	.0093	.0293	.0075	.1989	.0118	.005	.0018	.0218	.0029	.1926
Intermittent	.0101	.0057	0	.0215	0	.1934	.0009	.0009	0	.0027	0	.1834
Low flows	.0036	.0017	0	.007	.0002	.1855	0	0	0	0	0	.1825

Table D-17b. Adverse conditions affecting fish - usable habitat parameters (perennial streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Adult/Juvenile Habitat	.1864	.0179	.1506	.2222	.1215	.3074	.14	.0144	.1112	.1688	.091	.2701
Pools	.092	.0153	.0614	.1226	.0494	.2278	.078	.0109	.0562	.0998	.0467	.2178
Riffles	.0609	.0101	.0407	.0811	.0322	.1984	.0545	.0099	.0347	.0743	.0275	.195
Undercut banks	.0459	.0108	.0243	.0675	.0196	.1895	.0496	.0087	.0322	.067	.0265	.1923
Boulders	.0273	.0081	.0111	.0435	.0092	.1731	.0219	.006	.0099	.0339	.008	.1683
Snags	.0245	.006	.0125	.0125	.0097	.1684	.0292	.0098	.0096	.0488	.0072	.1736
Overhead Cover	.063	.0125	.038	.088	.0303	.2028	.0591	.0099	.0393	.0789	.0329	.2022
Egg/Larvae Habitat	.1406	.0157	.1092	.172	.0894	.2706	.1024	.0164	.0696	.1352	.0568	.2383
Gravel	.0875	.0124	.0627	.1123	.0527	.2271	.0624	.0101	.0422	.0826	.0339	.2019
Plants, Plant Debris	.0255	.0063	.0129	.0381	.0104	.1698	.0318	.0102	.0114	.0522	.0097	.1756
Other	.0149	.0044	.0061	.0237	.005	.1629	.0109	.0038	.0033	.0185	.0026	.1591
Intermittent	.001	.001	0	.003	0	.1508	.0009	.0009	0	.0027	0	.1507
Low Flows	.0014	.0009	0	.0032	0	.151	0	0	0	0	0	.1498

Table D-18a. Probable sources of factors adversely affecting usable fish habitat (all streams).

Probable Sources	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Excessive siltation	265169	23816	217537	312801	14712	399934	27.85
Bank erosion/sloughing	172960	20991	130978	214942	105935	321147	18.14
Channelization	110352	15810	78732	141972	62538	271242	11.6
Other channel modifications	4046	8984	28078	64014	22500	219001	4.84
Migration blockage	45007	9562	25883	64131	21404	218486	4.73
Natural	167308	18646	130016	204600	109275	323867	17.56
Other	43306	6872	29562	57050	23646	214238	4.55
Bank encroachment	12776	4288	4200	21352	3742	192177	1.34
Grazing	3351	2081	0	7513	0	183099	.35
Low flows	4182	1903	376	7988	292	183563	.44
Silviculture	4117	4117	0	12351	0	183912	.43

Table D-18b. Sources of adverse conditions affecting fish - usable habitat (perennial streams).

Probable Source	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Confidence Interval Biased		Percent
Excessive siltation	236094	21996	192102	280086	154285	345936	24.79
Bank erosion/ sloughing	152405	19398	113609	191201	92179	274769	15.98
Channelization	98068	14361	69346	126790	55083	230650	10.31
Other channel modifications	45396	8960	27476	63316	21936	187592	4.77
Migration blockage	39744	8383	22978	56510	18949	183226	4.18
Natural	127781	16070	95641	159921	79992	256599	13.41
Other	41080	6843	27394	54766	22069	182205	4.32
Bank encroachment	8975	3770	1435	16515	1236	157595	.94
Grazing	1678	1150	0	3978	0	150379	.18
Low flows	1470	1048	0	3566	0	150208	.15
Silviculture	4117	4117	0	12351	0	152844	.43

Table D-19a. Sources of adverse conditions affecting fish-usable habitat (all streams).

	Factor a Major Concern						Factor a Minor Concern					
			Confidence Interval						Confidence Interval			
Probable Cause	Proportion	Standard Error	Unbiased	(95%)	Biased		Proportion	Standard Error	Unbiased	(95%)	Biased	
Excessive siltation	.1791	.0206	.1379	.2203	.1118	.3423	.0994	.0116	.0762	.1226	.0618	.2724
Bank erosion/sloughing	.0997	.0172	.0653	.1341	.054	.2712	.0817	.0119	.0579	.1055	.0478	.2553
Channelization	.0781	.0138	.0505	.1057	.0403	.2564	.0378	.0074	.023	.0526	.0188	.2243
Other channel modifications	.0164	.0049	.0066	.0262	.0056	.2073	.032	.0084	.0152	.0488	.0123	.2197
Migration blockage	.0298	.0081	.0136	.046	.0109	.2176	.0175	.0049	.0077	.0273	.0067	.2072
Natural	.1058	.0156	.0746	.137	.0635	.2837	.0677	.0095	.0487	.0867	.0413	.2444
Other	.0325	.006	.0205	.0445	.0167	.2103	.0111	.0033	.0045	.0177	.0037	.2005
Bank encroachment	.0008	.0008	0	.0024	0	.1935	.0126	.0041	.0044	.0208	.0039	.2047
Grazing	.0035	.0022	0	.0079	0	.1958	0	0	0	0	0	.1927
Low flows	.0044	.002	0	.0084	.0003	.1964	0	0	0	0	0	.1927
Silviculture	.0043	.0043	0	.0129	0	.1967	0	0	0	0	0	.1927

Table D-19b. Sources of adverse conditions affecting fish - usable habitat (perennial streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Excessive Siltation	.1631	.0192	.1247	.2015	.1015	.297	.0848	.0107	.0634	.1062	.0515	.2273
Bank Erosion/Sloughing	.0875	.0157	.0561	.1189	.0466	.2293	.0723	.0107	.0509	.0937	.0421	.2149
Channelization	.0696	.0125	.0446	.0946	.0355	.2168	.0335	.0069	.0197	.0473	.0162	.1876
Other Channel Modifications	.0164	.0049	.0066	.0262	.0056	.1743	.0313	.0084	.0145	.0481	.0117	.1862
Migration Blockage	.0249	.0068	.0113	.0385	.0091	.1806	.0168	.0047	.0074	.0262	.0064	.1735
Natural	.0714	.0124	.0466	.0962	.0393	.2181	.0609	.0093	.0423	.0795	.0357	.2054
Other	.0313	.006	.0193	.0433	.0158	.1847	.011	.0033	.0044	.0176	.0037	.1673
Bank Encroachment	.0008	.0008	0	.0024	0	.1603	.0086	.0035	.0016	.0156	.0014	.1678
Grazing	.0018	.0012	0	.0042	0	.161	0	0	0	0	0	.1595
Low Flows	.0015	.0011	0	.0037	0	.1608	0	0	0	0	0	.1595
Silviculture	.0043	.0043	0	.0129	0	.01636	0	0	0	0	0	.1595

Table D-20a. Fish community factors adversely affecting fish (all streams).

Limiting Factors	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Fish kills	145827	18064	109699	181955	88134	295292	15.28
Contamination	90187	16636	56915	123459	46898	249135	9.45
Disease/parasites	24530	6908	10714	38346	7665	192080	2.57
Tumors/lesions	5101	4253	0	13607	0	175767	.53
Overharvest	35566	8488	18590	52542	15290	201648	3.73
Poaching	29447	9666	10115	48779	8281	197538	3.09
Underharvest	13671	4308	5055	22287	3963	182108	1.43
Fish stocking	19350	4792	9766	28934	8191	87284	2.03
Other	20880	4860	11160	30600	9095	188676	2.19
Competition	10836	4492	1852	19820	1498	180465	1.13
Water quality	5879	5072	0	16023	0	174590	.62
Habitat	15834	7398	1038	30630	955	185238	1.66
Low flow	5009	2278	453	9565	342	174763	.52
Small channel capacity	3702	2249	0	8200	0	173963	.39

Table D-20b. Adverse conditions affecting fish - fish community parameters (perennial streams).

Limiting Factors	Length (Miles)	Standard Error	Confidence Interval Unbiased (95%)		Biased		Percent
Fish kills	115435	15639	84157	146713	66288	237465	12.09
Contamination	81927	14966	51995	111859	42404	211559	8.58
Disease/parasites	21873	6377	9119	34627	6244	159041	2.29
Tumors/lesions	5101	4253	0	13607	0	145181	.53
Overharvest	35566	8488	18590	52542	15290	171270	3.73
Poaching	28145	9316	9513	46777	7807	165728	2.95
Underharvest	12714	4211	4292	21136	3402	150829	1.33
Fish stocking	19350	4792	9766	28934	8191	156902	2.03
Other	18063	4438	9187	26939	7426	155507	1.89
Competition	10836	4492	1852	19820	1498	149511	1.14
Water quality	5879	5072	0	16023	0	143900	.62
Habitat	14213	7315	0	28843	0	153423	1.49
Low flow	3194	1888	0	6970	0	142668	.33
Small channel capacity	1657	1152	0	3961	0	141391	.17

Table D-21a. Adverse conditions affecting fish - fish community parameters (all streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased	(95%)	Biased				Unbiased	(95%)	Biased	
Fish kills	.0686	.0121	.0444	.0928	.0364	.2431	.0842	.0124	.0594	.109	.0474	.2535
Contamination	.0358	.0097	.0164	.0552	.0135	.2142	.0579	.0117	.0345	.0813	.0285	.2323
Diseases/parasites	.0056	.0027	.0002	.011	.0001	.1874	.0201	.0068	.0065	.0337	.0045	.2007
Tumors/lesions	0	0	0	0	0	.1825	.0053	.0045	0	.0143	0	.1881
Overharvest	.0115	.0044	.0027	.0203	.0022	.1925	.0248	.007	.0108	.0388	.0091	.2041
Poaching	.0113	.0048	.0017	.0209	.0013	.1921	.0195	.0078	.0039	.0351	.0034	.201
Underharvest	0	0	0	0	0	.1825	.0143	.0045	.0053	.0233	.0042	.1949
Fishstocking	.0065	.0028	.0009	.0121	.0008	.1883	.0117	.0038	.0041	.0193	.0035	.1928
Other	.0095	.0033	.0029	.0161	.0024	.1908	.0113	.0036	.0041	.0185	.0032	.1924
Competition	.0094	.0039	.0016	.0172	.0013	.1905	.002	.0014	0	.0048	0	.1844
Water quality	.0062	.0053	0	.0168	0	.1869	0	0	0	0	0	.1825
Habitat	.0134	.0056	.0022	.0246	.0019	.1943	.0021	.0015	0	.0051	0	.1843
Low flow	.0043	.0022	0	.0087	0	.1862	.0009	.0009	0	.0027	0	.1833
Small channel capacity	.0039	.0024	0	.0087	0	.1862	0	0	0	0	0	.1825

Table D-21b. Adverse conditions affecting fish - fish community parameters (perennial streams).

Limiting Factor	Factor a Major Concern						Factor a Minor Concern					
	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Fish Kills	.045	.0092	.0266	.0634	.0209	.1874	.0759	.0118	.0523	.0995	.0417	.2149
Contamination	.0342	.0091	.016	.0524	.0131	.1804	.0508	.01	.0308	.0708	.025	.1935
Diseases/Parasites	.0056	.0027	.0002	.011	.0001	.1547	.0173	.0062	.0049	.0297	.003	.1655
Tumors/Lesions	0	0	0	0	0	.1498	.0053	.0045	0	.0143	0	.1555
Overharvest	.0115	.0044	.0027	.0203	.0022	.1599	.0248	.007	.0108	.0388	.0091	.1717
Poaching	.0113	.0048	.0017	.0209	.0013	.1595	.0182	.0073	.0036	.0328	.0031	.1669
Underharvest	0	0	0	0	0	.1498	.0133	.0044	.0045	.0221	.0036	.1616
Fishstocking	.0065	.0028	.0009	.0121	.0008	.1557	.0117	.0038	.0041	.0193	.0035	.1603
Other	.0086	.0032	.0022	.015	.0018	.1573	.0104	.0035	.0034	.0174	.0026	.159
Competition	.0094	.0039	.0016	.0172	.0013	.1577	.002	.0014	0	.0048	0	.1515
Water Quality	.0062	.0053	0	.0168	0	.1542	0	0	0	0	0	.1498
Habitat	.0117	.0055	.0007	.0227	.0006	.1603	.0021	.0015	0	.0051	0	.1516
Low Flow	.0033	.002	0	.0073	0	.1528	0	0	0	0	0	.1498
Small Channel Capacity	.0017	.0012	0	.0041	0	.1515	0	0	0	0	0	.1498

Table D-22a. Probable sources of adverse conditions affecting fish (all streams).

Probable Sources	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Heavy metals	20334	4971	10392	30276	7870	201729	2.12
Pesticides	72586	13076	46434	98738	34952	243563	7.56
Other noxious/toxic substances	68945	14397	40151	97739	31575	243670	7.18
Crowding	25678	6043	13592	37764	10402	206124	2.68
Other stress	33868	8970	15928	51808	12088	212526	3.53
Natural	132415	17447	97521	167309	78441	292453	13.78
Other	41794	7861	41794	57516	20306	219557	4.36
Angling pressure	6633	2756	1121	12145	857	191135	.69
Dewatering	6876	3364	148	13604	17	191084	.72
Humans	8741	4075	591	16891	543	193148	.91
Lack of access	6094	2753	588	11600	515	191020	.63
Municipal effluent	7144	4361	0	15866	0	191644	.74

Table D-22b. Sources of adverse conditions affecting fish - fish community (perennial streams).

Probable Source	Length (Miles)	Standard Error	Confidence Interval				Percent
			Unbiased (95%)		Biased		
Heavy metals	19382	4879	9624	29140	7271	167573	2.02
Pesticides	64670	11275	42120	87220	31637	203907	6.74
Other noxious/ toxic substances	64633	14075	36483	92783	28484	207120	6.74
Crowding	21962	5369	11224	32700	8568	169270	2.29
Other stress	30258	8057	14144	46372	10483	176337	3.16
Natural	98662	14910	68842	128482	54400	229534	10.27
Other	37873	7681	41794	53235	17505	183315	3.95
Angling pressure	6633	2756	1121	12145	857	157643	.69
Dewatering	6876	3364	148	13604	17	157659	.72
Humans	8741	4075	591	16891	543	159661	.91
Lack of access	6094	2753	588	11600	515	157457	.64
Municipal effluent	7144	4361	0	15866	0	158241	.74

Table D-23a. Sources of adverse conditions affecting fish - fish community (all streams).

	Factor a Major Concern						Factor a Minor Concern					
Probable Source	Proportion	Standard Error	Confidence Interval (95%)				Proportion	Standard error	Confidence Interval (95%)			
			Unbiased		Biased				unbiased		biased	
Heavy metals	.0074	.003	.0014	.0134	.0012	.2053	.0128	.0042	.0044	.0212	.0034	.2086
Pesticides	.032	.0087	.0146	.0494	.0112	.224	.0428	.0091	.0246	.061	.0189	.2339
Other noxious/toxic substances	.0327	.0095	.0137	.0517	.0111	.2273	.0391	.0102	.0187	.0595	.0148	.2306
Crowding	.0089	.0034	.0021	.0157	.0016	.2064	.0179	.0051	.0077	.0281	.006	.2138
Other stress	.0208	.0068	.0072	.0344	.0058	.2139	.0135	.0061	.0013	.0257	.0005	.2104
Natural	.0965	.0159	.0647	.0647	.0532	.2770	.0407	.007	.0267	.0547	.0217	.2265
Other	.0237	.0054	.0129	.0345	.0103	.217	.0161	.0047	.0067	.0255	.0052	.2111
Angling pressure	.0033	.0019	0	.0071	0	.2013	.0029	.0021	0	.0071	0	.2015
Dewatering	.004	.0024	0	.0088	0	.2015	.0031	.0026	0	.0083	0	.201
Humans	.0061	.0039	0	.0139	0	.2041	.0016	.0012	0	.004	0	.2003
Lack of access	.0019	.0013	0	.0045	0	.2005	.0045	.0026	0	.0097	0	.2026
Municipal effluent	.0037	.0036	0	.0109	0	.2011	.0038	.0027	0	.0092	0	.2025

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Table D-23b. Sources of adverse conditions affecting fish - fish community (perennial streams).

	Factor a Major Concern						Factor a Minor Concern					
Limiting Factor	Proportion	Standard Error	Confidence Interval				Proportion	Standard Error	Confidence Interval			
			Unbiased (95%)		Biased				Unbiased (95%)		Biased	
Heavy Metals	.0064	.0028	.0008	.012	.0007	.1687	.0128	.0042	.0044	.0212	.0034	.1729
Pesticides	.0268	.0069	.013	.0406	.0099	.184	.0398	.0086	.0226	.057	.0173	.1961
Other Noxious/Toxic Substances	.0311	.0092	.0127	.0495	.0102	.1905	.0362	.0099	.0164	.056	.0127	.1927
Crowding	.0089	.0034	.0021	.0157	.0016	.1697	.014	.0042	.0056	.0224	.0044	.1744
Other Stress	.0171	.0055	.0061	.0281	.0048	.1753	.0135	.0061	.0013	.0257	.0005	.1749
Natural	.0701	.0135	.0431	.0431	.0345	.2175	.0327	.0063	.0201	.0453	.0162	.1852
Other	.0206	.0051	.0104	.0308	.0081	.1788	.0151	.0046	.0059	.0243	.0047	.1748
Angling Pressure	.0033	.0019	0	.0071	0	.1655	.0029	.0021	0	.0071	0	.1657
Dewatering	.004	.0024	0	.0088	0	.1657	.0031	.0026	0	.0083	0	.1653
Humans	.0061	.0039	0	.0139	0	.1684	.0016	.0012	0	.004	0	.1643
Lack of Access	.0019	.0013	0	.0045	0	.1647	.0045	.0026	0	.0097	0	.1668
Municipal Effluent	.0037	.0036	0	.0109	.0036	.1653	.0038	.0027	0	.0092	0	.1669

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Table D-24a. Current reach conditions vs. past conditions (all streams).

	Current conditions - length (miles)						
Past conditions length (miles)	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	34,357	3,993	0	728	0	0	39,078
4	1,841	142,455	16,052	0	0	0	160,348
3	811	14,572	208,072	15,665	0	0	239,121
2	0	902	14,833	184,563	6,655	1,046	207,999
1	0	0	599	2,201	85,827	3,130	91,757
0	0	0	0	0	0	216,853	216,853
Current total	37,009	161,922	239,556	203,157	92,482	221,029	-

	Current conditions - standard error						
Past conditions standard error	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	6,931	2,129	0	728	0	0	7,364
4	1,304	12,858	4,712	0	0	0	13,329
3	811	4,456	17,299	4,112	0	0	17,480
2	0	902	4,466	15,062	2,744	1,046	16,366
1	0	0	599	1,272	10,227	1,849	10,296
0	0	0	0	0	0	19,451	19,451

Table D-24a. (concluded).

Past conditions proportion	Current conditions - proportion Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	0.9283	0.0246	0.0	0.0036	0.0	0.0	0.0409
4	0.0497	0.8798	0.0670	0.0	0.0	0.0	0.1679
3	0.0219	0.0900	0.8686	0.0771	0.0	0.0	0.2503
2	0.0	0.0056	0.0619	0.9085	0.0720	0.0047	0.2178
1	0.0	0.0	0.0025	0.0108	0.9280	0.0142	0.0961
0	0.0	0.0	0.0	0.0	0.0	0.9811	0.2270

Past conditions standard error	Current conditions - standard error Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	0.0404	0.0132	0.0	0.0036	0.0	0.0	0.0076
4	0.0351	0.0291	0.0193	0.0	0.0	0.0	0.0139
3	0.0214	0.0264	0.0244	0.0194	0.0	0.0	0.0158
2	0.0	0.0056	0.0183	0.0203	0.0287	0.0047	0.0157
1	0.0	0.0	0.0025	0.0063	0.0237	0.0082	0.0107
0	0.0	0.0	0.0	0.0	0.0	0.0089	0.0198

Table D-24b. Current reach conditions vs. past conditions, (perennial streams).

Past conditions length (miles)	Current conditions - length (miles) Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	33,478	3,993	0	728	0	0	38,199
4	1,841	137,674	16,052	0	0	0	155,567
3	811	14,572	197,176	11,465	0	0	224,024
2	0	0	14,833	151,911	3,321	0	170,066
1	0	0	599	2,201	45,990	0	48,790
0	0	0	0	0	0	29,872	29,872
Current total	36,130	156,239	228,660	166,306	49,311	29,972	-

Past conditions standard error	Current conditions - standard error Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	6,875	2,129	0	728	0	0	7,311
4	1,304	12,664	4,712	0	0	0	13,176
3	811	4,456	16,683	3,303	0	0	16,892
2	0	0	4,466	14,055	1,923	0	14,936
1	0	0	599	1,272	7,222	0	7,287
0	0	0	0	0	0	6,999	6,999

Table D-24b. (concluded).

Past conditions proportion	Current conditions - proportion Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	0.9266	0.0256	0.0	0.0044	0.0	0.0	0.0400
4	0.0509	0.8812	0.0702	0.0	0.0	0.0	0.1629
3	0.0224	0.0933	0.8623	0.0689	0.0	0.0	0.2345
2	0.0	0.0	0.0649	0.9134	0.0674	0.0	0.1780
1	0.0	0.0	0.0026	0.0132	0.9316	0.0	0.0511
0	0.0	0.0	0.0	0.0	0.0	1.0	0.0313

Past conditions standard error	Current conditions - standard error Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Past total
Class							
5	0.0414	0.0137	0.0	0.0043	0.0	0.0	0.0075
4	0.0360	0.0296	0.0203	0.0	0.0	0.0	0.0136
3	0.0219	0.0272	0.0257	0.0192	0.0	0.0	0.0153
2	0.0	0.0	0.0191	0.0206	0.0381	0.0	0.0146
1	0.0	0.0	0.0026	0.0077	0.0381	0.0	0.0076
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0072

Table D-25a. Current reach conditions vs. future conditions (all streams).

Future conditions length (miles)	Current conditions - length (miles)						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	29,794	5,861	859	0	0	0	36,515
4	4,224	139,792	13,022	0	0	0	157,039
3	1,153	19,454	184,142	7,168	0	0	211,917
2	0	0	40,599	166,274	0	0	206,872
1	0	0	830	24,443	89,355	0	114,628
0	0	0	0	5,342	3,139	220,673	229,245

Future conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	6,292	3,272	859	0	0	0	6,990
4	1,987	12,978	3,894	0	0	0	13,669
3	1,153	5,601	17,117	2,340	0	0	17,830
2	0	0	7,852	13,897	0	0	15,748
1	0	0	830	4,902	10,599	0	11,987
0	0	0	0	3,090	1,555	19,915	20,792

Table D-25a. (concluded).

Future conditions proportion	Current conditions - proportion						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	0.8471	0.0355	0.0036	0.0	0.0	0.0	0.0382
4	0.1201	0.8467	0.0544	0.0	0.0	0.0	0.1642
3	0.0328	0.1178	0.7690	0.0353	0.0	0.0	0.2216
2	0.0	0.0	0.1695	0.8182	0.0	0.0	0.2163
1	0.0	0.0	0.0035	0.1203	0.9661	0.0	0.1199
0	0.0	0.0	0.0	0.0263	0.0339	1.0	0.2397

Future conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	0.0743	0.0197	0.0036	0.0	0.0	0.0	0.0072
4	0.0532	0.0364	0.0162	0.0	0.0	0.0	0.0140
3	0.0313	0.0324	0.0342	0.0115	0.0	0.0	0.0167
2	0.0	0.0	0.0314	0.0278	0.0	0.0	0.0155
1	0.0	0.0	0.0035	0.0222	0.0170	0.0	0.0120
0	0.0	0.0	0.0	0.0148	0.0170	0.0	0.0212

Table D-25b. Current reach conditions vs. future conditions - (perennial streams).

Future conditions length (miles)	Current conditions - length (miles)						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	28,923	5,861	859	0	0	0	35,644
4	4,224	134,738	13,022	0	0	0	151,984
3	1,153	18,815	175,128	7,168	0	0	202,264
2	0	0	38,720	135,216	0	0	173,937
1	0	0	830	21,293	48,613	0	70,735
0	0	0		2,704	704	29,862	33,270

Future conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	6,231	3,272	859	0	0	0	6,935
4	1,987	12,890	3,894	0	0	0	13,614
3	1,153	5,416	16,407	2,340	0	0	17,041
2	0	0	7,647	12,875	0	0	14,904
1	0	0	830	4,658	7,381	0	9,070
0	0	0	0	1,610	704	6,997	7,190

Table D-25b. (concluded).

Future conditions proportion	Current conditions - proportion						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	0.8432	0.0368	0.0038	0.0	0.0	0.0	0.0373
4	0.1232	0.8452	0.0570	0.0	0.0	0.0	0.1589
3	0.0336	0.1180	0.7762	0.0431	0.0	0.0	0.2115
2	0.0	0.0	0.1694	0.8127	0.0	0.0	0.1819
1	0.0	0.0	0.0036	0.1280	0.9857	0.0	0.0740
0	0.0	0.0	0.0	0.0162	0.0143	1.0	0.0348

Future conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Future total
Class							
5	0.0760	0.0204	0.0037	0.0	0.0	0.0	0.0072
4	0.0546	0.0369	0.0170	0.0	0.0	0.0	0.0139
3	0.0320	0.0326	0.0351	0.0141	0.0	0.0	0.0159
2	0.0	0.0	0.0318	0.0299	0.0	0.0	0.0148
1	0.0	0.0	0.0036	0.0257	0.0143	0.0	0.0092
0	0.0	0.0	0.0	0.0093	0.0143	0.0	0.0074

Table D-26a. Current reach conditions vs. future controlled conditions (all streams).

Future controlled conditions length (miles)	Current conditions - length (miles)						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	36,216	37,972	15,693	5,746	0	1,624	97,251
4	3,990	145,054	119,373	20,194	5,506	0	294,116
3	0	0	137,777	114,179	3,411	0	255,367
2	0	0	3,172	75,000	39,516	6,331	124,019
1	0	0	0	2,392	38,627	1,157	42,176
0	0	0	0	0	2,673	117,103	119,776

Future controlled conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	7,828	7,517	6,563	4,055	0	1,624	13,397
4	2,405	15,535	15,075	4,482	2,701	0	21,359
3	0	0	16,902	14,546	1,993	0	21,499
2	0	0	3,172	10,352	8,654	3,810	13,372
1	0	0	0	1,727	8,043	1,157	8,317
0	0	0	0	0	1,958	21,303	21,584

Table D-26a. (concluded).

Future controlled conditions proportion	Current conditions - proportion						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	0.9008	0.2075	0.0569	0.0264	0.0	0.0129	0.1043
4	0.0992	0.7925	0.4325	0.0928	0.0614	0.0	0.3153
3	0.0	0.0	0.4992	0.5249	0.0380	0.0	0.2738
2	0.0	0.0	0.0115	0.3448	0.4404	0.0502	0.1330
1	0.0	0.0	0.0	0.0110	0.4305	0.0092	0.0452
0	0.0	0.0	0.0	0.0	0.0298	0.9278	0.1284

Future controlled conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	0.0544	0.0384	0.0230	0.0184	0.0	0.0127	0.0142
4	0.0544	0.0384	0.0444	0.0205	0.0303	0.0	0.0214
3	0.0	0.0	0.0460	0.0436	0.0223	0.0	0.0209
2	0.0	0.0	0.0115	0.0415	0.0677	0.0303	0.0139
1	0.0	0.0	0.0	0.0079	0.0692	0.0093	0.0086
0	0.0	0.0	0.0	0.0	0.0213	0.0338	0.0220

Table D-26b. Current reach conditions vs. future controlled conditions (perennial streams).

Controlled conditions length (miles)	Current conditions -length (miles)						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	34,668	37,972	12,339	5,746	0	1,624	92,349
4	3,990	137,662	118,426	17,194	2,543	0	279,815
3	0	0	130,914	102,636	3,411	0	236,958
2	0	0	3,172	58,195	26,020	3,090	90,476
1	0	0	0	951	26,288	0	27,239
0	0	0	0	0	1,698	28,983	30,681

Controlled conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	7,673	7,517	4,101	4,055	0	1,624	12,318
4	2,405	15,450	15,028	4,065	1,800	0	21,619
3	0	0	16,065	14,119	1,993	0	20,750
2	0	0	3,172	9,241	6,926	2,340	11,724
1	0	0	0	951	7,243	0	7,286
0	0	0	0	0	1,698	8,868	9,029

Table D-26b. (concluded).

Future controlled conditions proportion	Current conditions - proportion						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	0.8968	0.2162	0.0466	0.0311	0.0	0.0482	0.0990
4	0.1032	0.7838	0.4471	0.0931	0.0424	0.0	0.3000
3	0.0	0.0	0.4943	0.5556	0.0569	0.0	0.2540
2	0.0	0.0	0.0120	0.3150	0.4340	0.0917	0.0970
1	0.0	0.0	0.0	0.0051	0.4384	0.0	0.0292
0	0.0	0.0	0.0	0.0	0.0283	0.8601	0.0329

Future controlled conditions standard error	Current conditions - standard error						
	Class 5	Class 4	Class 3	Class 2	Class 1	Class 0	Controlled total
Class							
5	0.0564	0.0404	0.0153	0.0216	0.0	0.0477	0.0130
4	0.0564	0.0404	0.0447	0.0221	0.0301	0.0	0.0217
3	0.0	0.0	0.0459	0.0480	0.0331	0.0	0.0205
2	0.0	0.0	0.0120	0.0455	0.0850	0.0682	0.0124
1	0.0	0.0	0.0	0.0052	0.0898	0.0	0.0076
0	0.0	0.0	0.0	0.0	0.0272	0.0821	0.0094

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16. Abstract (Limit: 200 words)

This report presents initial results of the National Fisheries Survey, an assessment of the biological condition of the Nation's waters conducted jointly by the U.S. Environmental Protection Agency (EPA) and the U. S. Fish and Wildlife Service (FWS) in 1982. Sport fish species, Federally-designated threatened and endangered fish species, and State-designated fish species of special concern were used as indicators of biological status. For the purposes of this Survey, the Nation's waters were defined as all flowing waters in the contiguous 48 United States, coastal waters, and wetland areas. This report is the first in a three-volume series and is intended for use by professional fishery biologists and water quality management personnel; Federal and State decision-makers and planners; and the general public.

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Survey

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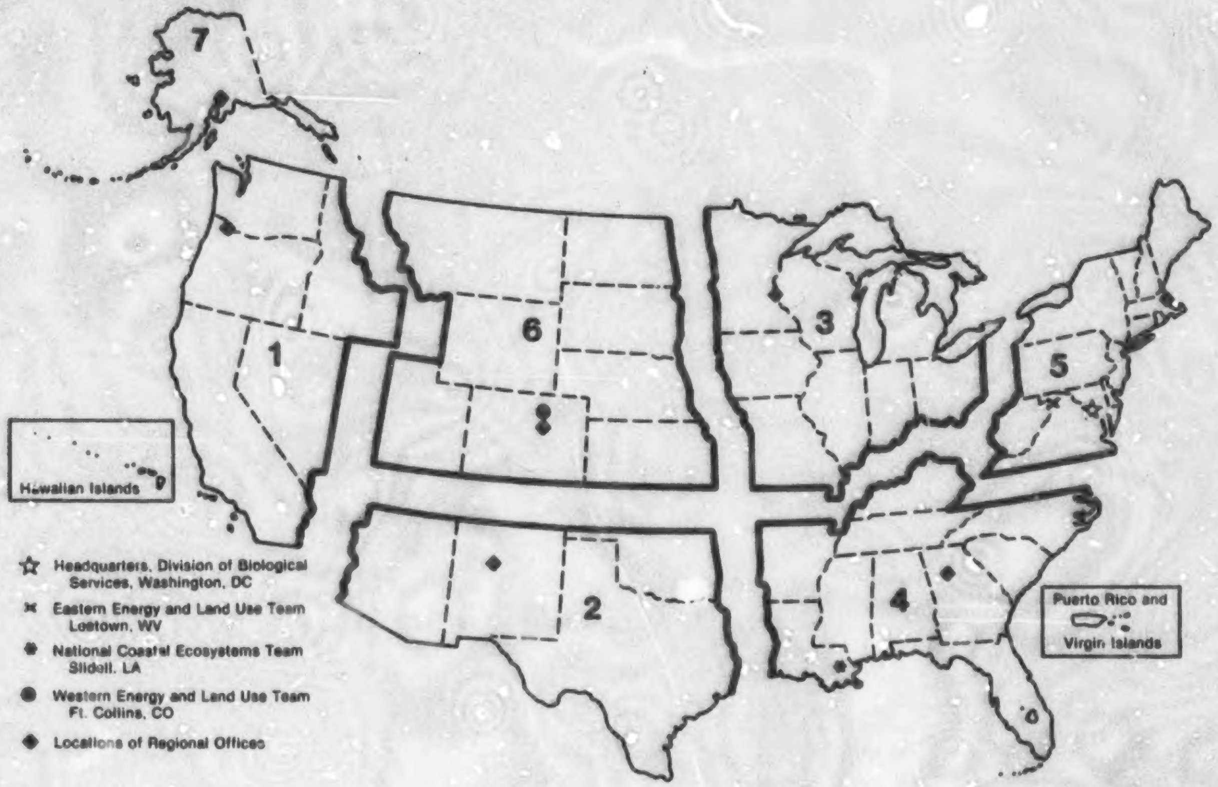
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DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.